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The Science Teacher

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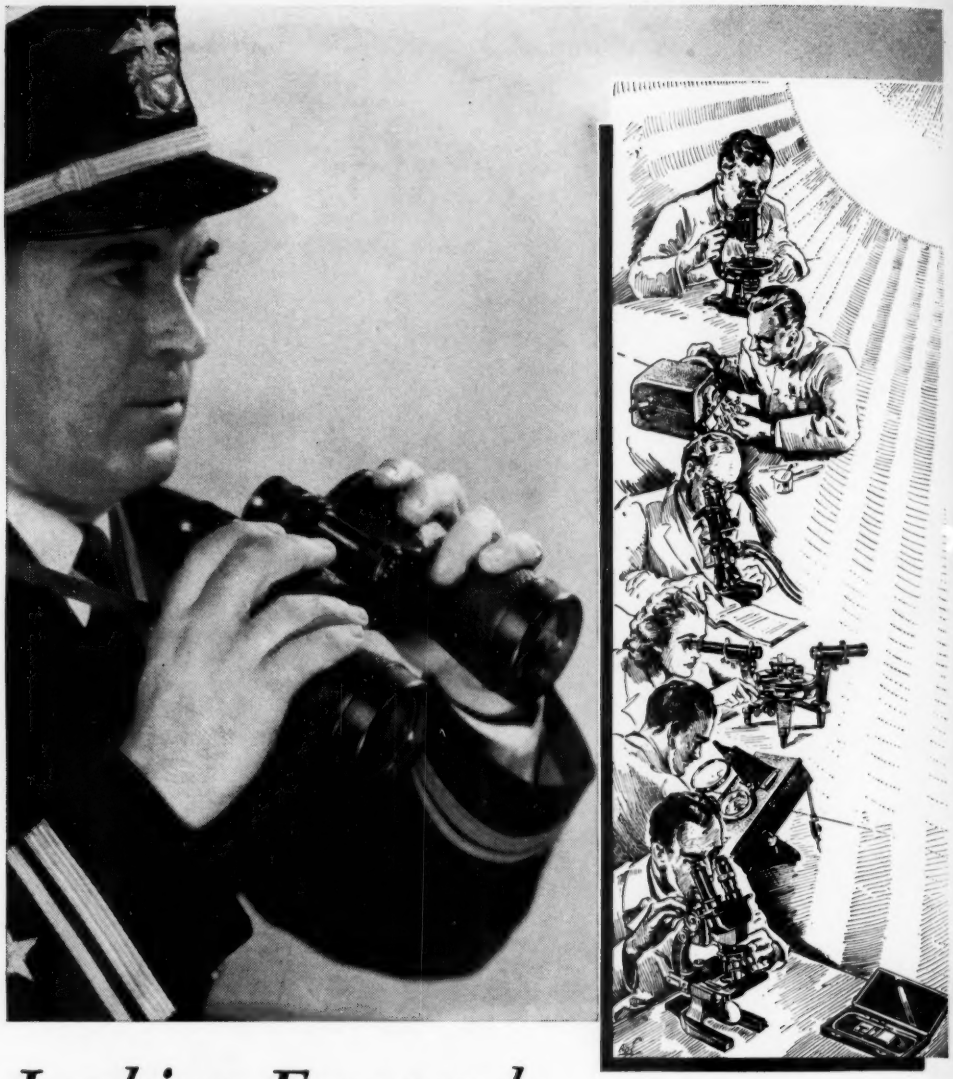
A National Service Journal

APRIL
1944
Volume XI
Number 2
Published
OCTOBER
DECEMBER
FEBRUARY
APRIL



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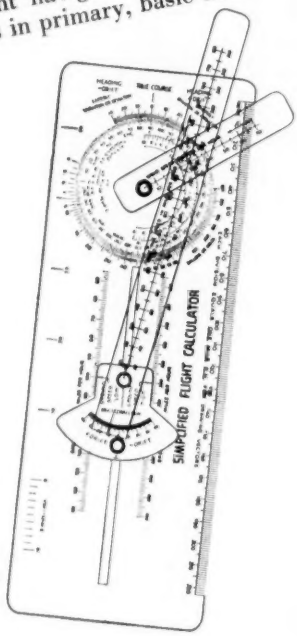

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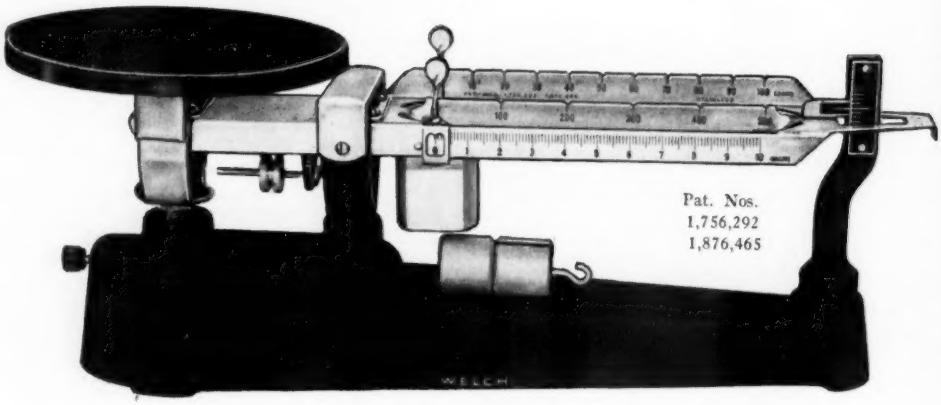

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VOLUME XI APRIL, 1944 NUMBER 2

Pre-Induction Training in the High School

JOHN M. MASON

University Laboratory High School Columbia, Missouri

THE PURPOSE of this discussion is to present some of the objectives for a pre-induction program in the high schools, to review some of the problems connected with the offering of pre-induction ocurses, and to draw some conclusions as to the things that we as science teachers can do to make a pre-induction program worthwhile.

Objectives for a Pre-Induction Program

I assume that every teacher is aware of the fact that much better teaching can be done when both the teacher and the student know the objectives for which they are working. The inclusion of "wartime" courses in our curriculum has offered us the opportunity of teaching certain subjects in which the student can see the immediate worthwhileness of the subject. It is our job to set up worthwhile objectives and then to stimulate and direct the student toward the achievement of these objectives.

BEFORE going further, I would like to comment briefly on some of the factors that influence our objectives. Pre-induction courses were developed as "wartime" courses and, therefore, their objectives should be "wartime" objectives. It seems to me to be only natural that such objectives should be determined in a large measure by the needs of the Armed Forces, of critical industries, and of pre-services that will contribute to the war effort. When these needs change, I personally belive that the objectives for the pre-induction courses should change. If they should not, then we teachers had better take stock of the philosophy by which we have been teaching.

You are probably familiar with the objectives for "wartime" courses as listed in the Victory Corps bulletin. We are interested, for the purpose of this discussion, with those objectives listed as follows: Competence in Science and Mathematics, Pre-flight training, and pre-induction for critical occupations. The major objectives of a "wartime" program in mathematics and science are very effectively stated on page eight of the "High School Corps" bulletin,"Victory Corps Series, Pamphlet Number 7. These objectives are:

"1. To inject definiteness of purpose and new drive for mastery into the conduct of existing courses.

2. To emphasize those parts of existing courses which have real value in meeting wartime needs of pupils.

3. To find present and real applications of principles in the military or production areas to use wherever possible.

4. To develop new or emergency courses which may serve the needs of youth who have a short time to prepare themselves for entry into a specific field of military or civilian service.

5. To plan refresher and supplemental opportunities for pupils who have not recently studied such subjects as arithmetic or physics and will soon have need to use skills and understandings related to them.

6. To devise means by which individual pupils or small groups within a more general class or course may direct their emphasis and study toward the special requirements of the field of work they are preparing to enter."

Condensed from a paper presented before the Friday morning discussion group of the Missouri State Teachers Association, November 5, 1943, St. Louis, Missouri.

I THINK that you will agree with me that these are immediate major objectives for a "wartime" course, and I believe that they are typical of the objectives that you might set up for any of the pre-induction courses. I consider then to be worthwhile mainly from the standpoint of the teacher and in order for them to become vital to the student each objective would have to be broken down into specific objectives for specific courses. I realize that the foregoing statement is unnecessary to the teacher that has a complete picture of the correlation of objectives. The point I want to make is that specific course objectives should definitely correlate with the objectives for a pre-induction program.

To illustrate my point, I cite the objectives listed for Unit One. "How We Measure Matter" in the Emergency Physics part of the bulletin "Wartime Emergency Courses For Missouri High Schools." The objectives are:

1. To orient the student in the use of measurement.

2. To enable the student to make and explain calculations regarding matter.

3. To show the application of mensuration to the war program.

I think that you can see here an effort to correlate this unit with some of the major objectives for an emergency course in Physics. This is the thing that we should constantly strive to do in developing unit objectives for our pre-induction courses.

IN DEVELOPING the objectives for our courses, I thing that we will miss a rare opportunity if we do not attempt to stimulate the student into wanting to plan and in helping to plan the objectives for the course. A great many of our students know at least what they intend to do in the near future, such as try for the air corps, and, we should use the present situation to develop that desirable cooperation between teacher and student. It is my belief that goal directed activity will stimulate better initial responses, will make for more definite and conscious effort on the part of the student, which will in turn lead to improvement and fixation of the thing to be learned. The development of worthwhile objectives will ,to my way of thinking, pay large dividends to the student.

Some Problems in a Pre-induction Program

In a recent issue of the Kansas City Teacher there appeared an editorial entitled "Priority of Educational Priorities," and in this editorial the fact was emphasized that educators are being urged to provide certain pre-induction courses. At the same time, they are also being urged to provide courses and activities that are not directly related to the war effort, but still of sufficient importance to be included in the curriculum. Just what things are to be given priority?

I believe that a great many of us have been confronted with similar problems. As I have already suggested, our goals should be determined by certain needs, and it seems to me that we are apparently at a place where we need to have some of the factors which determine our goals clarified. If such a question as the Armed Forces' actual plans for students with pre-induction training could be answered, it would throw some light on the advisability of offering certain courses. The same could be said for critical manpower needs and other pre-service training needs. Authoritative statements and reliable surveys should prove of value in determining "wartime" priority for educational priorities.

ANOTHER problem is that of teacher shortage. There is not, as I see it, any immediate solution. Teachers in related fields have helped by volunteering to teach some of the pre-induction courses. They have by hard work undoubtedly offered satisfactory courses, but there is even too few of these teachers. The government is aware of this shortage, but as yet, as far as I know, have done nothing to remedy the situation. Thus in certain pre-induction courses, the lack of anyone qualified in the field or in related fields has made the offering of these courses impossible. Fundamentals of shopwork being an example.

Both the large city school and the smaller high school are confronted with problems peculiar to their own school. The small school has such problems as whether to drop subjects, such as physics and chemistry, and

offer subjects, such as pre-flight or some other pre-induction course, or to try to offer both. Laboratory equipment and adequate laboratory space are also problems encountered, as well as the teacher shortage problem. Again, I believe that our objectives must be known in order to solve these problems effectively. At the present time, I think that in a school having a small enrollment, such courses as chemistry and physics should be retained and that the content material be organized around objectives which would emphasize their war application and importance. It is possible,

THE LARGE city school has too many problems connected with a pre-induction program to attempt to list them here. The question of priorities is very apparent in the large city high school. I shall not attempt to cite nor to suggest solutions for any of the problems of the large city's pre-induction program. However, these problems would make an interesting basis for fruitful group discussion.

Concerning this question of problems connected with a pre-induction program, I think that it is a good sign to see administrators and teachers in both the large and small cities studying current problems, and attempting to solve these problems. From such studies, a better curriculum will doubtlessly be developed for both the large and the small high school.

Some Suggested Things That Will Contribute To The Worthwhileness Of A Pre-induction Program In The High School

IN ORDER for a pre-induction program to be worthwhile, the program should be founded on some sound concepts. I should like to close my discussion with some suggestions for making a pre-induction program worthwhile.

First, I believe that teachers should have a basic understanding of the reasons for offering pre-induction courses. This understanding involves the needs and the purposes to be served by such courses. Therefore, teachers should set up definite objectives for their courses, and they should teach in the light of the objectives which they set up.

Second, administrators and teachers need to know the truth of "wartime" needs, so that they may plan, in good faith, the programs for their schools. They should examine carefully the available information as to "wartime" needs, and the objectives which they eventually set up should be based upon their findings after careful study. It would be helpful if the government would furnish to school officials up-to-date information as to their needs. Some effort has been made in this direction and programs based upon such information are definitely more satisfactory from both the administrator's and the teacher's viewpoint, than programs which are initiated just to have a pre-induction program.

THIRD, teachers can add to the worthwhileness of their classes by taking advantage of the impact of the war influence on the students with which they work. Students, as a whole, are motivated to do, to the best of their ability, something that will better fit them to serve their country. Therefore, insead of strictly textbook teaching, more student planned activity can be brought into actual practice. Pre-induction courses offer fine opportunities to develop student-teacher relationships that are conducive to good learning situations.

Fourth, pre-induction courses by stressing modern problems and the application of known facts to everyday situations, breaks away from some types of traditional teaching, and in so doing, provides information that will not only be usable during wartime, but also during peacetime. The teacher should bring their subject content material up to-date.

Fifth, in order for a pre-induction program to be worthwhile, the teacher must stimulate and direct the student according to the student's abilities and aptitudes. Guidance is sill a vital part of the work of the teacher.

SIXTH, it is my firm belief, that even though our immediate problem is to train students for specific tasks and our immediate objectives are "wartime" objectives, we still must keep alive the spark that underlies the philosophy of the good life.

For our pre-induction courses to be really worthwhile, we must train students for the present and for the future.

Editorial and News

Merging of National Associations

ONE OF the most promising forward steps in the coordination of science teacher association activities that has occurred in many years is that of the merging of the American Council of Science Teachers and the American Science Teachers Association as now proposed by leaders of each of these groups and by leaders of other science teacher organizations.

This forward looking move taken at the recent Pittsburgh meeting of representatives of the leading national science teacher organizations was not taken in haste, but came as a result of careful study of organization problems. The move has been advocated by leaders of both the A.S.T.A. and the American Council for several years and has been quite carefully as well as favorably considered. The chief difficulty seemed to be that concessions had to be made by both groups in order for merging to be possible.

THE METHOD of merging chosen is most fortunate. By forming an entirely new organization to absorb both groups, all barriers to the establishment of a strong and unified association are removed. Under the plan all interests concerned can feel they are fairly served, as no requirements are imposed by the original groups and adjustments can be made as needed.

The plan of organization of the proposed new National Science Teachers Association is especially outstanding in two ways. It closely ties the groups to the two largest national organizations of interest to science teachers, the National Education Association and the American Association for the Advancement of Science, and it allows other science teacher groups to affiliate with the National Science Teachers Association and work closely with it in furthering an active program.

BEING a department of the N.E.A. allows the association to have a close working relationship in the educational field. This feature has already proved of great value in cooperative action during this present war period. Being an affiliate of the A.A.A.S. brings closer contact with the research phase of and the advancements in pure science, and also helps to give those interested in pure science a better concept of and a greater interest in the science education problem. The close relationship to the A.A.A.S. deserves to be maintained.

The matter of other science teacher groups affiliating with the National Science Teacher Association is also a vital feature, as it allows close cooperation among organized groups and permits more effective work. (See the statement of science education problems on page 12 to be considered.) Affiliation will no doubt remain flexible as in the past to meet the needs of the various organizations. In any event direct membership in the new national association should be encouraged as a means of increasing its strength just as is the case with the N.E.A.

FOR FURTHER information concerning the new association, all should read the statement concerning the merging of the American Council and the A.S.T.A. (see pages 12 and 13) and also the constitution of the new National Science Teachers Association. Members of these organizations are urged to send in their vote on the proposition to the proper officer as indicated at the close of the article.

★

REPORT CHANGE OF ADDRESS

If you change your school address during the summer, report the change to *The Science Teacher* so you will receive your October issue. The post office does not forward second class matter and the October issue would not reach you.

Council Notes

Edited by NATHAN A. NEAL, Secretary
AMERICAN COUNCIL OF SCIENCE TEACHERS

THE 1944 election of the ACST is being conducted by means of ballots included within each member's copy of the April issue of the *Science Teacher*. The nominating committee has given careful consideration to various possibilities in connection with the 1944 election. After due deliberation, the committee has decided the most effective policy is to offer a slate which lists the names of all of the present officers as candidates for a second term. The ballots include spaces for write-in candidates for the various offices. These ballots should be returned by direct mail to the Secretary of the Council as indicated at the bottom of the ballot. Council members are especially invited to fill in the spaces provided on the ballot for suggestions concerning improved service of the Council and topics which it would be desirable to have discussed through articles in the Journal.

A major factor in the thinking of the nominating committee has been the proposed one-day Council meeting in Pittsburgh on July 4, 1944. The committee has wisely assumed that present officers are in a position to effectively arrange and conduct a meeting. The problems which have arisen during the conventionless year of 1943 will be brought up for discussion. The theme of the one-day sessions on July 4 will be "The Influence of the War on Science Teaching." This theme will be carried on through the 1944 Yearbook of the Council which is planned to appear as a supplement to the October, 1944 issue of the *Science Teacher*.

IF ANY Council member who reads this statement has any suggestions for speakers who are especially qualified to discuss specific aspects of the influence of the war on science teaching or to prepare articles related to this theme for the 1944 Yearbook, any such suggestions would be appreciated by the secretary, who is also Chairman of the Yearbook Committee, and should be sent in immediately, in order to be useful in the early planning for both the convention and the Yearbook. Topics planned for discussion include the fields of pre-flight aeronautics, pre-induction electricity and mechanics, biology, physics, and chemistry; also, general statements on "Look Ahead in Science Teaching," "Science Teaching for the Early Post-War Period," and others.

If any Council member has material on changes which have taken place in his own classroom, or in his school, due to the War, send brief descriptions of these to the Editor of the Yearbook. It is hoped that the 1944 Yearbook may include a section on such brief summaries of wartime science teaching experience.

Send your Council membership dues to your state director or any officer of the Council.

★

MEMBERSHIP

The National Educational Association records show that they are well on the road to reach their quota of 330,000 members by May 31st as on Dec. 31st they had surpassed by 20,000 the total membership for the 1942-3 school year.

Likewise the American Council of Science Teachers has shown a fine increase in membership already having surpassed the 1942-3 school year membership by approximately 50%. If each of you would secure a membership from a fellow teacher, our membership could easily be more than doubled. How about it?

★

ARKANSAS MEETING

Dr. Charles H. Cross, The Council's State Director, arranged a very successful program for the science teachers of Northwest Arkansas, which was held at Fayetteville, on Friday, February 18th. Lt. Col. Jay Dykhouse of the Eighth Service Command of the Pre-Induction Branch of the War Department, was the principal speaker.

Continued on page 33

One Big Association for Science Teachers

National Science Teachers Association Formed To Join For National Service The Two National Science Teacher Organizations.

THE AMERICAN Council of Sicence Teachers, a Department of the N.E.A., and the American Science Teachers Association, an affiliate of the A.A.A.S., will shortly be merged into a unified national organization, named the National Science Teachers Association, when the membership of the two fusing organizations approve this forward step toward unity and greater effectiveness. Other influential organizations interested in science teaching will cooperate by affiliating with the unified N.S.T.A.

Action toward the merger was taken at a conference of representative delegates of leading science teacher organizations held at Pittsburgh on Saturday, April 1, and Sunday, April 2.

The N.S.T.A. was actually organized by adopting a constitution and temporary by-laws, pending action by the A.C.S.T. and A.S.T.A. and the development and adoption of permaenent by-laws. Temporarily the organizing committee under the chairmanship of Dr. Philip G. Johnson, of Cornell, will serve as the board of directors, but provision has been made for the retirement of this committee when the officers and directors, representative of all fields of science teaching, are ready to take over, as the first regular officers of the N.S.T.A.

To assure that an additional organization will not result, the liquidation of the new N.S.T.A. on Dec. 31 of this year is provided in the event that the fusion has not been accomplished by that time.

Platform for Action

A PLATFORM for action on behalf of science teachers was tenatively adopted at the Pittsburgh conference. This explains that N.S.T.A. shall formulate and promote adoption of programs for science instruction at elementary, secondary and college levels, training and certification of science teachers. Policies are to be enunciated with regard to individual laboratory work, apparatus and equipment, textbooks, science clubs, visual and auditory aids, discovery and development of science talent, and the coordination of instructional materials developed by different agencies.

The platform will be concerned with the contribution of secondary school science to the war on military and home fronts, science studies for those returning from war service or industry, programs of adult education in science, the effect of a possible year of national service for all boys and girls in the post-war era, and decreasing the lag between developments in research laboratories and work in science classrooms.

OTHER policy problems in education to be considered include: coordination of vocational and liberal education, health, international relation, conservation, leisure-time activities, use of science for solving human problems and for human betterment, intercultural relations, guidance, etc.

Merger of A.C.S.T. and A.S.T.A. into the N.S.T.A. is made feasible by the following circumstances:

1. Both use the same magazine
2. Memberships overlap considerably
3. Purposes and objectives are similar.
4. Services rendered are parallel.

THE CONSTITUTION FOR THE NATIONAL SCIENCE TEACHERS ASSOCIATIONS

Article I.

Name and Affiliations

Section 1. This organization shall be known as the National Science Teachers Association.

Section 2. This organization of science teachers shall be an affiliate of the American Association for the Advancement of Science and a department of the National Education Association. Through cooperating organizations it shall have official connections with other scientific and professional groups.

Section 3. The letters N.S.T.A. as hereinafter used shall mean this single general organization of science teachers.

Article II.

Purposes

Section 1. The general purpose of the National Science Teachers Association shall be to stimulate, improve, and coordinate science tecahing at elementary, secondary, and collegiate levels of instruction.

Section 2. The general aims which are to be pursued in atempts to achieve the general purposes are as follows:

(a) To make the influence of science teacher organizations a potent force through the unification of their efforts.

(b) To initiate and maintain a national effort by scientists and educators to the end that the sciences may be given a just and reasonable opportunity to serve the needs of all youth and adults.

(c) To plan a long range program for the improvement of science teaching.

(d) To assist scientists and science teachers to work together and have a voice along with other groups; such as teachers in other subject matter fields, supervisors, and administrators, in defining plans and policies for public education.

(e) To stimulate widespread and intelligent cooperative action on problems related to science teaching.

Article III.

Membership

Section 1. The qualifications, classifications, and rights of members shall be as defined in the by-laws.

Article IV.

Officers and duties

Section 1. The officers of the N.S.T.A. shall consist of a president, one or more vice-presidents, a secretary, a board of directors, and such other officers as shall be prescribed in the by-laws.

Section 2. The powers and duties of officers and directors, together with the method of their election, shall be as prescribed in the by-laws.

Article V.

Amendments

Section 1. Amendments to this constitution shall be made by a 2/3 vote of the board of directors and subject to such requirements as may be prescribed in the by-laws.

By-laws

1. The board of directors shall consist of the following members of the organizing committee.
   1. Maurice U. Ames, New York City Federation of Science Clubs
   2. Florence Billig, National Assn. for Research in Science Teaching
   3. John C. Hogg, New England Chemistry Teachers Association
   4. Norman R. D. Jones, American Council of Science Teachers
   5. Emil L. Massey, Central Assn. of Science and Mathematics Teachers
   6. Morris Meister, American Science Teachers Association
   7. W. H. Michener, American Assn. of Physics Teachers
   8. Hugh C. Muldoon, Catholic Conference of Science Teachers
   9. Laurence L. Quill, Division of Chemical Ed., American Chemical Society
   10. Merle A. Russell, National Association of Biology Teachers
   11. Reuben T. Shaw, Middle State Association of Science Teachers
   12. Dwight E. Sollberger, American Nature Study Society

   Philip G. Johnson, Acting Chairman, Cornell University and the Ithaca Public Schools.

The board shall continue to function until the proposed consolidation of the American Council of Science Teachers and the American Science Teachers Association shall have been completed and approved by this board, at which time the board shall be reconstituted in accordance with the consolidation of the Council Association.

The board may add to its membership and take all other action it deems necessary.

Unless the consolidation of the Council and the Association is effected by Dec. 31, 1944, the N.S.T.A. shall go out of existence.

The board of directors may take action by mail or telegraphic ballot.

Organization Unity Provides Strength

ORGANIZATION unity can provide strength for the promotion of sound principles and practice in science teaching. Past efforts at cooperation and united action in this field have not been sufficiently successful. The war and its certain aftermaths raise new and critical problems for science teaching and teachers. These can not properly be solved by local or special groups acting alone. There is great need for coordination and for singleness of purpose on a national scale and at all levels of the educational system.

★

Your Vote on the Merger is Needed

Do you approve giving authority to your executive committee to proceed with such steps as are necessary for effecting the merger of organizational resources of the A.C.S.T. and the A.S.T.A? This vote will be closed and counted on May 10, 1944.

A.S.T.A. members should register their vote on the proposed merger by writing directly to: Dr. Morris Meister, High School of Science, 120 E. 184th Street, Bronx, New York City.

American Council members please write "Merge" or "Do not merge" on the election ballot and send it to Mr. Nathan A. Neal, Board of Education, Cleveland, Ohio.

Effect of Pressure on Boiling Point of Water

A HIGH SCHOOL PHYSICS DEMONSTRATION

M. J. W. PHILLIPS

West Allis High School — West Allis, Wisconsin

SIMPLE, and easily made apparatus can be assembled to demonstrate the relationship of temperature and pressure in boiling water. Figure I. shows a diagram for the arrangement of the flasks and mercury manometer tube. The whole is mounted in permanent form upon a base board and can be kept intact from year to year. Most of the material consists of scrap pieces and can be assembled by an ingenious pupil as a project.

The base board is a piece 7½ inches wide, ¾ inch thick, 18 inches long. Two cleats are fastened under this board as shown. Along one side of this board, two ½ inch holes are bored through which are glued the twelve inch lengths of one-half inch dowel rod which support a strip of wood 1 by 1½ inches, 18 inches long. This strip serves to support the flasks and the board holding the yard stick, meter stick, and mercury manometer tube.

The flasks are supported by ⅜ inch carriage bolts, fastened to the strip supported by the dowel rods. The center flask, 250 cc., is supported by a burette clamp attached to a ⅜ inch carriage bolt, 10 inches long. This is fitted with two nuts, one on each side of the strip to hold it firmly. The large flask, 500 cc., at the left is held in place by a burette clamp fastened to a ⅜ inch carriage bold 6 inches long. This bolt is also attached to the same strip supported by the dowel rods as described. This arrangement keeps the flasks in perfect alignment.

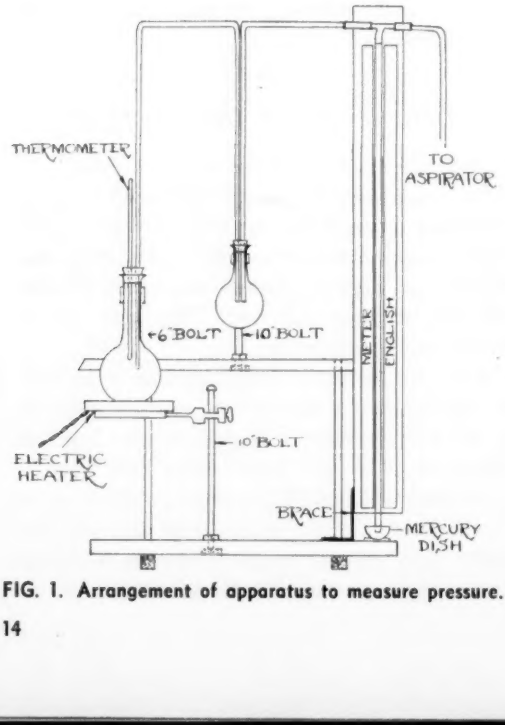

FIG. 1. Arrangement of apparatus to measure pressure.

FIG. 2. Electric heating unit attached to laboratory ring. Note strip of metal held in place by dry cell binding post.

THE ELECTRIC heating unit is supported under the flask by a ⅜ by 10 inch carriage bolt attached to the base board as shown in Figure I. and Figure III. This electric heating unit is 500 watt, from a discarded electric cooking utensil. It was furnished by one of the pupils in the physics class. Figure II. shows how it is attached to a standard laboratory ring, which supports it on the bolt in place of a ring stand. This electric heating unit will boil the water under atmospheric pressure, in the flask, in about five minutes.

The pressure measuring device at the right, Figure I. and Figure III., consists of a board, 3 inches by ¾ inch, 31 inches long, screwed onto the strip supporting the flasks as shown. The lower end is 2½ inches above the base board in order that a small dish of mercury can be placed under the end of the glass tube fastened to the board. On the right of the glass tube is a yard stick cut to 30 inches; on the left a meter stick cut to 75 centimeters, in length. These sticks are slotted with a 3/16

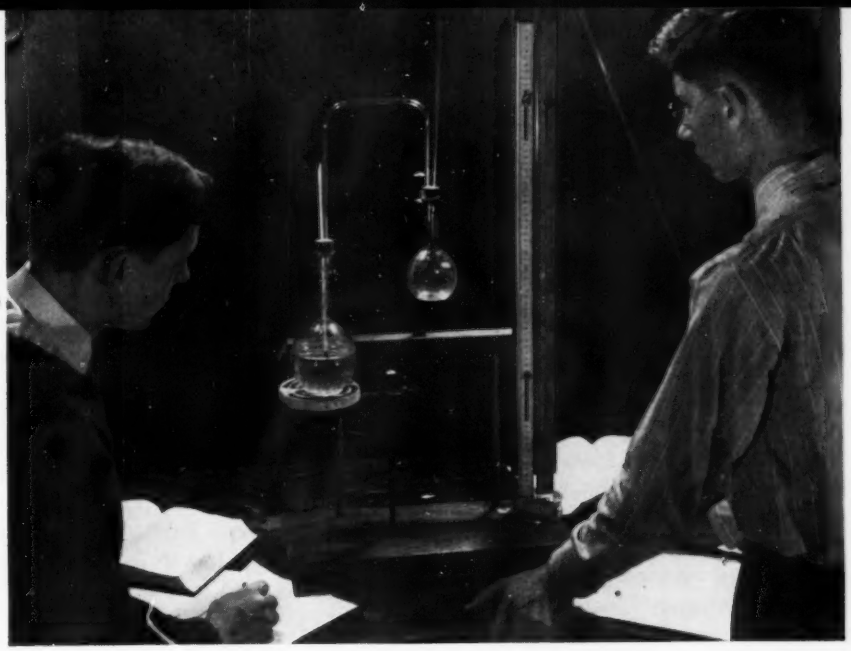

FIG. 3. Reading temperature and pressure from apparatus.

inch slot into which is fitted a 3/16 by 1½ inch stove bolt with wing nut. This serves to adjust the yard stick and meter stick to measure accurately the distance from the top of the mercury in the dish to the top of the mercury in the tube. The lower slots have loosely fitting screws and washers so the sticks will slide up and down easily.

THE GLASS tubing connecting the various parts as shown is put in place after the equipment is built. The glass tubing is bent in such a manner as to have as few rubber connected joints as possible. Air and steam is carried directly from the boiling water in the 500 cc. flask at the left to the 250 cc. flask in the center, which serves as a trap for any condensed water. A thermometer is placed through the rubber stopper in the flask at the left to record the temperature. There is a T tube at the top of the mercury manometer and is connected as shown with short pieces of rubber tubing.

The 500 cc. flask can be filled ⅔ full of water and the stoppers and glass tubing cemented in with rubber cement. This serves to keep all the joints air tight. The water can be kept in the apparatus from year to year, since evaporation is very little when used for short periods at a time under low temperature and at reduced pressure.

This equipment needs only to be attached to an electric outlet, an aspirator, and a dish of mercury placed under the manometer tube. It is then ready for operation.

Figure IV. shows a graph, made from the readings taken with this equipment. This graph gives excellent practice in plotting data. The pupils are asked to prepare their own

Continued on page 34

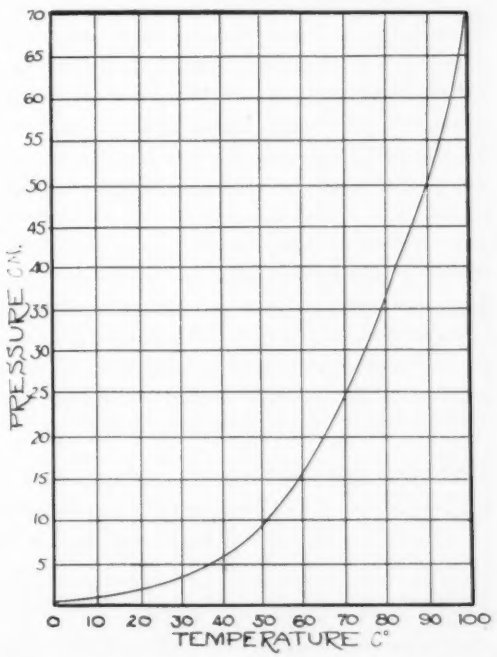

FIG. 4. Relationship of reduced pressure and boiling point of water.

Report "Teaching Suggestions for P.I.T. Bulletin 101, Fundamentals of Electricity"*

R. WILL BURNETT
Stanford University

[CONTINUED FROM FEBRUARY ISSUE]

VI. ELECTROMAGNETISM

AS INDICATED in the section on Magnetism, the applications of electromagnetism in military operations are very important. For pre-induction training, the student will see the practical significance of his work with electromagnetism if instruction is oriented toward motors and communication devices in which this phenomenon finds expression.

The student has already become familiar with the principles and theory of magnetism. In this unit, study is focused on an understanding of the principles of electromagnetism, and upon uses of the electromagnet in machines and devices. Many applications of the electromagnet appear in familiar devices, which are also used or are counterparts of those used in warfare. Thus the instructor may readily secure or improvise demonstrator equipment for effective teaching.

Opportunity for a great deal of direct experience with electrical devices should be provided. Solenoids, the circuit breaker, simple relays, telegraph apparatus, electric balls, telephone receivers, and other electrical devices may be studied in detail. Simple working models which may be constructed will aid the student in attaining a much clearer understanding of electromagnetism in practice and theory. The use of electromagnets in automobile circuits, studied in detail, should be especially valuable to the prospective inductee because of the general similarity of such circuits to those of military vehicles.

Illustrative Activities

1. Simple electromagnets may be constructed with and without soft iron cores and their relative strength determined. (Use a rheostat and ammeter in the circuit to provide a constant current strength when making comparisons of strength.) The strength of the magnets may be determined roughly by the quantity of tacks or small nails they will pick up. Add turns of wire and note the difference in strength when the current flowing through the magnet remains constant.
2. Examine the construction of a telephone receiver, an electric bell or buzzer, a door chime, a telegraph relay, telegraph sounder, and circuit breaker. Experiment with these devices, noting the action of the electromagnets they employ.
3. Simple buzzers, relays, circuit breakers, and telegraph keys may be constructed and operated by the students.
4. In their reading, students may be interested to learn more about the use of relays in apartment houses (releasing the door latch from a distance), in telephones (particularly dial telephones where many thousand relays make the necessary contacts), and in elevator signals, etc.
5. Certain automobiles are started by pressing a small button with the hand. This activates a relay which makes the contact for turning over the starting motor. The relay may be studied by diagrams or in the actual mechanism.

VII. METERS

THE INSTRUMENT panel of an airplane is a maze of meters, indicators, and gages which are meaningless except to those trained to read, understand and interpret them. But the safety of plane and occupants may be dependent also upon the accuracy with which each instrument fulfills its function.

This suggests a type of preliminary training that may well be valuable for the prospective inductee, since the Army has use for men who

*This report was drawn up by R. Will Burnett, Assistant Professor of Science Education, Stanford University, formerly consultant of the Pre-induction Training Branch of the War Department. The following persons collaborated in the report: Philip G. Johnson, Cornell University; Lester Williard, Elizabeth, New Jersey; Nelson Becker, Albany New York; Millard W. Bosworth, Vermont Academy, Santon River, Vermont; and Wendell P. Gee, Detroit, Michigan.

understand the operation and construction of meters. The student's experience with meters in his home has doubtless impressed him with civilian dependence on measuring instruments. He should also be given experiences which enable him to visualize the function of meters in military operations.

Inherent in the use and maintenance of meters is a great respect for their delicacy and for the precision with which they must measure. It is important that students be impressed with the delicacy of precision meters and the care needed in using and maintaining them. Because of the small contact area between pivot and jewel (so designed to reduce friction) there is an extremely high pressure on the pivot. This presure is enormously increased with rough handling or dropping of the instrument; the result may be that of cracking the jewel or mushroom pivot.

THE CIRCUIT placement of voltmeters, ammeters, and ohmmeters should be carefully analyzed in relation to partial and total circuit measurement. Internal and external circuits should be recognized. Moreover, skill in the use of meters implies familiarity with the units of measure and their significance.

Illustrative Activities

1. Students should observe the construction and operation of galvonometers, ammeters, and voltmeters. The differences between the D'Arsonval galvanometer and the Weston type instrument may be studied. Essential parts and functions of the Weston permanent-magnet, moving-coil instrument should be noted; for example, pivots, jewels, springs, damping frame, pointer and counterweight, and zero adjuster.
2. The principles underlying operation of meters may be better understood by the students if they experiment with the construction and calibration of one or more types of meters, using simple equipment and varying current strengths and resistances.
3. Students should practice placing meters in various circuits and taking readings. (The activities listed under Section V may have provided the students with sufficient experience of this type.)

VIII. HEATING EFFECTS OF ELECTRIC CURRENT

CABLES attached to the starting motors of tanks, Army trucks, and armored vehicles are short and heavy—possibly one inch in diameter. A loose and frayed cable, or one which has been wrenched loose from its attachment leaving a few strands of small diameter will, of course, become overheated and possibly burn off at a moment of crucial importance.

The Army driver and the Army maintenance man must understand the fundamental relationship of resistance, current, and heat expressed in the formula: Calories of heat equal .24 I^2RT. The student should be led to see these fundamental principles in their application in generators, motors, heating filaments, and so forth.

The heating effects of an electric current are put to many uses in military operations as in welding-arcs, audiones, carbon-electrode searchlights, incandescent lamps, unit heaters such as hospital heating pads, the pilot's suit-heater, stoves, and space heaters. Many such effects are in an indispensable feature of military operations, but they may create difficulties in the form of over-loaded, over-heated circuits that call for expert handling.

EXAMPLES of the transformation of electrical energy into heat energy are well known to the student, but over-heating of circuits is usually prevented by devices of which he is seldom aware.

The student should have experiencce with the safety factors of heat fuses and circuit breakers. He should be familiar with types of lamps such as the incandescent and the fluorescent, and he should understand the heating effects and current drain in series and parallel circuits.

Illustrative Activities

1. Suspend a section of nichrome wire on an insulating stand and connect in series with a rheostat and a fifteen- or thirty-ampere fuse. Decrease the resistance in the rheostat and observe the increasing amount of heat in the nichrome wire.
2. Study the heating effect on a wire of in-

creasing the current or the resistance. If, in the above experiment, an ammeter is placed in series with the resistance wire, the calories of heat produced may be determined by application of the formula; calories equal .24 I^2RT. The fact observed in Experiment 1, that the heat is increased as the resistance is reduced, may be shown mathematically by use of the above formula.

3. Repeat the experiment with an ammeter in the circuit, using a nichrome wire of the same diameter but half the length. Leave the rheostat set as it was when the entire length of wire was used. Repeat with one-fourth the length of the original wire. Note the results in increased heat and determine the increased heat by use of the above formula. The student should be led to understand the danger of overheating resulting in a burned-out wire and the possibility of a fire from the arc produced when the wire separates.
4. Examine various heating elements such as those found in toasters, heating pads, etc. Attach such a device to the 110-volt power source in series with an ammeter. Determine the resistance of the device by application of Ohm's Law and compute the production of heat over a short period of time.
5. Examine cartridge and plug type fuses. Place a fuse in a single socket without other resistances and attach to the 110-volt source. Examine the burned-out fuse. Discussion should center on the use and necessity of fuses, properly selected to allow the passage of current which is safe for the wires in use in a circuit.
6. Examine the fuse in an automobile circuit and consider the danger of replacing such a fuse with a fuse of considerably higher rating.
7. The electrical thermostat may also be studied. Note the action of an oven thermometer, using the same principle, when a direct source of heat is applied. Reference should be made to the use of electrical thermostats which will permit temporary overloads but will break the circuit if the overload is continued for a sufficient number of seconds to heat the bimetallic bar and cause it to bend.

IX. WORK, ENERGY, AND POWER

THE FUNDAMENTAL fact that energy may be transformed into other forms underlies both the production and use of electricity in practical affairs. Students will have already had considerable examples of this transformation of energy in their study of the production of electricity through friction and chemical action. Attention may be directed here to the fundamental units of energy, work, force, and power and to these concepts as they apply to electrical devices.

The preceding unit considered the transfer of electrical energy to heat energy. This section may therefore include the transfer of heat energy to electrical energy, with attention to the practical importance of this transfer in the thermocouple.

Illustrative Activities

1. The thermocouple provides a ready indication of the temperature of motors. Military aircraft use them in various parts of the engine. The students should study the nature of the thermocouple and the advantage of this heat-indicating device in producing a thermoelectric effect which can be read on a properly calibrated milli-voltmeter in the cockpit of a plane.
2. The thermoelectric effect of a thermocouple may be noted by twisting together the ends of two dissimilar wires (such as iron and copper), and attaching the other ends to a galvanometer. Apply a direct source of heat to the ends twisted together and note the effect on the galvanometer reading. Increase the heat and note the effect. The student should be able to see the possibility of calibrating a dial so that a direct reading of temperature might be made.
3. The above is one example of the transfer of energy from one form to another. Discussion may be centered on other transfers of energy—chemical to electrical, electrical to heat, mechanical to electrical, etc.
4. The concepts of energy, work, force, and power should be developed through discussion and simple experiments. The dis-

tinction between potential and kinetic energy may be studied through analyzing the action of the storage battery when charged and in process of discharging.

5. Students should understand the definition of the watt as the unit of electrical power. They may experiment with common electrical devices to determine the wattage by taking voltmeter and ammeter readings. These may be compared with the listed ratings on the devices. The watt-hour, the unit of electrical work, should also be learned in terms of its applications.

X. INDUCED ELECTROMOTIVE FORCE

THE GENERATION of electricity provides the motive force for innumerable devices essential to military operations. Airplanes, tanks, tank destroyers, tractors, jeeps, transport vehicles of many types must function faultlessly for maximum service. An indispensable unit in such performance is the generator. Grasp of the fundamentals of electromotive induction may be of inestimable value to the soldier whose responsibility it is to get his vehicle into action and keep it operating.

In case of faulty operation of mobile units it is the job of the automotive electrician or the automotive mechanic to locate, diagnose, and if possible, correct the cause. The difficulty may sometimes lie in the generator. Diagnosis must be made quickly, based upon accurate knowledge, and repair, adjustment, or replacement effected.

In addition to furnishing electric current to mobile units, generators are essential to the operation of lighting and communications systems, whose efficient performance must be constantly maintained. In the field, manually operated generators are sometimes used, as in target range communication systems.

INSTRUCTIONS should be so designed as to cover not only the basic theory of A.C. and D.C. generators, but also to provide an abundance of practice with simple equipment and the assembling of generators. In this way the student learns the purpose each part of the generator serves, where the generator breakdowns occur, whether repairs or replacements are required, how to make very simple adjustments, and how best to take care of the generator.

Illustrative Activities

1. The principle of induced current may be developed by simple experiments with magnets and wires and helixes connected to galvanometers. Study of references, diagrams, and simple experiments should result in a thorough understanding of generator action.
2. The distinctive features of series-wound, shunt-wound, and compound-wound generators should be studied. Attention may be called to the general advantages of the compound-wound and shunt-wound generators over the series-wound type.
3. Considerable time could profitably be spent in the study of typical generators, such as those used in automobiles. Students should observe the construction and learn the elements of proper care and maintenance. The effect of drawing more current than the maximum for which the generator is rated should be noted and reference made to the heating effects in wires as expressed by the formula: calories equal .24 I^2RT. The nature of the current adjustor on automobile and other generators should be studied. Simple experiments and the use of diagrams showing the lines of force cut by a rotating wire in a field may be used to make the action of the current adjustor clear. Proper lubrication should be considered together with the danger of excessive oiling.
4. Portable military transmitter and receiver systems sometimes operate by the use of hand-operated generators. A magneto should be studied as a simple hand-operated type of generator using permanent magnets to produce field strength. Students may construct simple hand-operated generators. (Instructions may be found in various textbooks on pre-induction electricity.)

XI. MOTORS

IN MILITARY occupations, as in industry, and in the home, many machines are driven by their own electric motors. The electric

Continued on page 44

Science for Society

EDITED BY JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Chinese Industrial Cooperatives are destined to play a vital role in the cause of the United Nations and in a new China which will emerge from our victory in this war. Three fourths of the present output of the 157,192 cooperatives goes to fill hospital and army needs. Some supplies have actually been going to United States military units, saving valuable airplane cargo space. Recalling the statement by Admiral Nimitz about the coming defeat of Japan on Chinese soil and from Chinese bases, we can anticipate a considerable contribution from the Chinese cooperatives to our coming military operations.

Upon a firm foundation of training in engineering at Cambridge, David Leacock has amassed considerable experience of a unique nature which particularly qualifies him to speak on the subject of Chinese Industrial Cooperatives. He was instrumental in helping small fruit farmers in the Canary Islands form highly successful marketing and shipping cooperatives. He installed power plants and hydraulic works with hundreds of miles of water supply lines. When he could not get what he wanted, he trained his own mechanics and made it on the spot from available material. After Franco's troops took over the Canary Islands, Mr. Leacock became Technical Director of Indusco, as the American Committee in Aid of China Industrial Cooperatives is known. His services have been invaluable in helping to solve some of the problems peculiar to Chinese industry.

The following was presented as a talk to the American Association of Scientific Workers, held at the Men's Faculty Club of Columbia University, January 13, 1944.— J. S.

China in the Process of Reconstruction

DAVID LEACOCK

CHINA as a whole is a very backward country. Before the war, she had some modern industries in the coastal cities. These greatly weakened her home industries. In many cases, the skills and practices of a thousand years were almost lost in this pre-war period. The industries in these coastal cities used very little power. In 1925, the total amount of power available in some 400 plants was 250,000 kilowatts. Of this, Shanghai produced 121,000 and Canton 12,000.

When the war came, the Chinese removed a small amount of their machinery and some of their workers into the interior and various plans were worked out for setting up industries to produce the immediate needs of Free China. Most of these plans were based on the assumption that they would be able to import modern machinery. This was understandable as most of the engineers were either American or foreign trained and could see production in terms of 20th century machines. There were some others, however, who were more occupied with the immediacy of the problem. These people set about making plans based on improving the methods and processes which had been used in China for centuries. The plans for setting up the twentieth century type of industries were not very successful. As part of the equipment which had been lost could not be replaced, owing to its great weight and owing to the kind of materials used in its construction, the whole plant was useless. In another case, the steel plant was set up, but, as the transportation facilities were inadequate, and there was no means of building a required railway, the iron ore had to be carried a great distance on the backs of men. The product was far tooo expensive of labor even for China. In other cases, broken parts could not be replaced, and so whole plans were put out of gear.

AFTER the closing of the Burma Road, the idea of importing machinery was more or less given up. Engineers in China concentrated on improvising and improving on what they already had. Among the first to make a concerted effort toward the improvement of existing Chinese methods, were the people

who promoted the Chinese Industrial Cooperatives. They had three main objectives:

1. To enable as many people as possible to earn a livelihood.
2. To enable them to produce goods which were badly needed.
3. To start industry on a new basis. They wanted industry developed locally, with ownership in the hands of the workers.

The idea of setting up numerous small rural industries had a great deal to recommend it. It largely solved the transportation problem both of getting material and disposing of the products. It enabled the raw materials in the area to be worked up by local labor. The smallness of the buildings made them comparatively safe from bombing; and the small size of the equipment made it possible, in many cases, for the equipment to be removed when the Japanese overran the district.

THE SETTING up of rural industries also might bring long range benefits and help solve China's very difficult agrarian problem. China's land is greatly subdivided, with strips, in same cases, only a quarter to four acres in size. It is practcially impossible to use efficient mechanical means to plough or cultivate land on this basis. Due to inflation and to the present system of taxes, the size of the larger holdings will increase. The small holdings system is all right for certain types of horticulture, but is very inefficient for main crop farming. It means that a great many people get a meager existence from the land. In many cases, they are victims of what the economist calls concealed unemployment, for much of their time is not adequately utilized.

China has developed many handicraft industries, such as basketmaking, home weaving, embroidery work, making of carpets and rugs, and so on. By setting up small efficient industries, whose products can compete in quality with those of the large factories, workers can be taken from the land and their labor employed in working up local products. At the same time, they can still live in their homes. The employment of some of the land workers means that the people with small acreages will either sell or rent their strips to the large farmers or join a village farming cooperative, as the Mexicans have so successfully done. In this way, the land can be made to produce much more, and the cost of the land products can be reduced. By teaching skills to the workers who have been displaced their wages will automatically rise. If they work in a mechanical industry, the products of their work can be turned out economically.

THERE is no question but that the first thing that backward people in a village ask for is education. Therefore, one of the first things that the cooperatives did was to start technical schools in conjunction with their cooperatives. After education, they would probably like to have electric light and power. The electric light problem is one which the cooperatives, in most cases, have not been able to solve, owing to the difficulty of getting dynamos. They have, however, been able to put in some power plants, particularly waterwheels. After the war, no doubt, one of the first things that they will do will be to supply the electric light and expand electric power production.

The smith and the carpenter will want tools and machines. It is interesting to note here that the very first cooperative that was started consisted of nine blacksmiths who were brought together and to whom a loan was made so that they could put in a drill press, a lathe and a few other machines. The setting up of machine shops is one of the things that has been emphasized by the cooperative organizers. The importance of the machine shops will become even more evident after the war when it becomes possible to supply larger ploughs to be drawn by heavier animals, or possibly mechanized equipment. Truck transportation also depends to a large extent on the existence of machineshops which can do repairs. Many power-driven mills for grinding wheat and corn have already been set up by the Chinese cooperatives. More will be needed. The next development that one might expect in a small community is the need for more clothing. Cotton spinning will develop in the cotton areas; and in the wool areas, the spinning of wool yarn. It was in this field that the cooperatives have thus far made their most important contributions. They have made more than two and one half million blankets. They started by helping carpenters

Continued on page 37

The Laboratory in the Food Industry

R. W. FOGLER

Illinois State Normal University Normal, Illinois

THE PROCESSING of food in the past has been an art, but today it is fast becoming a science. The laboratory is coming to the fore and is controlling every process that the food undergoes from the "cradle to the grave." The laboratory controls the variety of seed, the treatment of seed, the minerals in the soil, the harvesting date, the preparation, blanching, and cooking of the food, the type of container, the cooling process, the handling and the storage.

The modern laboratory is divided into five main divisions: namely, agricultural research, research on new products, nutritional research, quality control, and research on objective measurements in grading. In the limited space of this article, it will be impossible to give more than a passing glance at the functioning of these various departments in bringing to the consumer the best possible product from the standpoint of quality and nutrient value.

THE AGRICULTURAL research division develops the hybrid, controls the minerals in the soil so that various products will contain the desired amount of minerals; it also controls insects, blights, and various fungus growths that interfere with the yield and quality of the product harvested. For example, some fields of beets when cut showed dark spots which greatly detracted from their appearance in the can, and this defect decreased their market value. The agricultural research division discovered that when twenty pounds of borax per acre were added to the soil the beets did not develop these dark spots. This is just one of the many contributions that this phase of the laboratory is contributing to the packing of better foods.

The quality control division has as its field all factors which go to make up quality as outlined by the Food Distribution Administration of the United States Department of Agriculture. For example, in the harvesting of any products, the determining of the correct stage of maturity is of prime importance. If corn is too young it is watery or in the blister stage and has very little flavor. It reaches its optimum stage of maturity for packing as whole kernel either in vacuum or brine when it is in the milk stage. However, for the cream style pack it is desirable to allow the corn to reach the cream stage. After it passes the cream stage of maturity it goes into the dough stage, and finally into the starch stage, both of which are highly undesirable. Each stage may be identified by the per cent of moisture present; as the corn becomes more mature the per cent of moisture drops.

THESE various stages of maturity are determined by scientific tests made on samples brought in from the field. About fifty days after planting the fields are checked for silks, and from the day the corn is silked the ripening unit count is started and continued until it reaches the desired number. At that time a careful sampling of the field is made for the pre-tests and the sample is brought to the moisture laboratory. The sample is weighed, husked, and the mature ears are sent through the cutter and made ready for grinding. The ground corn is weighed into aluminum trays and placed in the Brabender for forty-five minutes. The percentage of moisture is then calculated and the maturity of the corn is thereby established. If the moisture percentage is found to be too high, the corn is allowed to remain in the field until the required moisture level for fancy maturity is reached. The length of time required to change the moisture one percentage point depends upon the temperature, and when this, in turn, is converted into ripening units, it serves as a reliable guide to the proper harvesting time. The number of ripening units in a day is determined by subtracting 49 from the temperature each hour in the day and then adding the twenty-four differences to obtain the total ripening units for the day. Scientific procedure has replaced the old method of sticking the thumb nail into the kernel to determine the degree of maturity.

OTHER vegetables are subjected to scientific tests to determine their state of maturity. For example, the maturity of peas can be determined by the Alcohol Insoluble Test. This test consists of determining the amount of insoluble solids in ethyl alcohol. As the peas mature they become more starchy and thus more alcohol insoluble solids are formed. Therefore, peas in the fancy range of maturity have a certain amount of insoluble solids, while those in the choice range have a higher alcohol insoluble solid value. The percentage of alcohol insoluble solids have been so well determined for all grade levels and all varieties of peas that the results of these tests will be accepted in courts when the maturity of the peas sold is being contested.

Science serves in many capacities other than ascertaining proper maturity in determining the quality of the product that goes into the can. In the grading of corn, consistency constitutes 25% of the grade, and it is very important that the cream style corn goes into the can with the proper viscosity. Corn of the proper consistency does not pour from the can as thin as water, nor does it remain inside when the can is inverted, but it flows at such a rate that when it hits the tray it has a tendency to mound and level off very slowly. To obtain the required consistency the per cent of syrup and the per cent of corn, as well as the maturity of the corn, must be controlled very carefully. This control is effected by means of viscosimeter readings which are made on every mixer of corn that goes through the blender. Any time the viscosimeter readings vary (they are taken every eight minutes) adjustments are made at the De Zurich to prevent the corn from becoming too thick or thin, whichever the case may be.

SCIENCE further follows the can into the cook room and finally to the cooling pit. The water of the cooling pit must be continually chlorinated and tested so that .5 parts per million of chlorine are present to assure the destruction of any bacteria that might be found in the cooling water. This precaution is necessary because as the can comes from the retort the solder is hot and may have made pin hole openings in the can which will breathe in water until the solder is cool and hard again. If contaminated water should enter, spoilage will result. In times like these it is necessary that the laboratory take every precaution to save every can for the Army, Navy, Lend-Lease and civilian consumption.

There are still many other functions that science performs in controlling quality, however, space will not permit relating further services performed in the quality control area.

The third division served by science in the laboratory is the field of nutrition. A few years ago nutrition was a word used and understood only by scientists. Today it is a word used by millions of American families, and its real value in maintaining the health of the nation is being more thoroughly understood. In the past many of the vitamins that are present in the fresh fruits and vegetable were destroyed in the canning operation. It does not necessarily follow that if Vitamin C is found in fresh tomato juice that the same amount or any amount will be found in canned tomato juice. It is the purpose of the nutritional research division to see that the proper procedures are worked out so that vitamin content will be maintained to a high degree in the canned product.

The laboratory examines samples periodically to ascertain the number of vitamin units found in each can of the various products. If there is any deviation from the minimum standard, steps are taken at once to correct the condition. Every possible effort is made to have the maximum amount of nutrients in every can packed.

THE FOURTH area of the laboratory, research on new products, likewise could not exist without the scientific method and the facts of science. Because of the lack of shipping space, it was very urgent that new ways of preserving food that required less volume be developed. Since 1939, the laboratory has devoted much of its time to the dehydration of fruits and vegetables. The problem of rehydration has been studied very intently and the degree to which it can be simplified will be the determining factor of how well the public accepts dehydrated foods in the post war world, since dehydrated foods are nutri-

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Importance of Insects in War Time

C. L. METCALF

University of Illinois — Urbana, Illinois

[CONTINUED FROM FEBRUARY ISSUE]

FOR THE piercing-sucking insects, which cannot be killed by stomach poisons, applied to the plants, contact insecticides should be used. These are substances applied as sprays or dusts, which will poison the insects without being swallowed, usually by penetrating through the spiracles or breathing holes along the sides of the insect's body, and reaching the delicate internal tissues through the elaborate branching system of breathing tubes or tracheae.

Contact insecticides cannot be used in a preventive way, by applying to the plants before the insects' attack, because, in order to kill, these insecticides *must hit the insect;* and only those insects actually hit by the spray or dust will be killed. Consequently, even greater thoroughness is required than in applying stomach poisons.

The oldest, most-widely used, and one of the best, contact insecticides is nicotine, the poisonous alkaloid extracted from tobacco leaves. Highly concentrated extracts of nicotine sulphate, such as "Black Leaf 40," are available at many stores. By dissolving two ounces of soap-powder, soap-flakes or shaved-laundry-soap, adding it to five gallons of water and then stirring in an ounce of nicotine sulphate, a spray is formed that will kill all soft-bodied insects hit by it. For those, who use dust guns instead of spray pumps, the same nicotine sulphate may be thoroughly mixed with hydrated lime at the rate of one ounce of the nicotine solution to each pound of lime. The ingredients should be placed in a can with a tight-fitting lid, a few clean stones about the size of golf balls added, and the can rolled over and over for 10 or 15 minutes until every particle of the lime is impregnated with the nicotine. Keep the can tightly closed and use the dust as soon after mixing as practicable, preferably on a hot, dry, still day. Such nicotine dusts or sprays are the standard control for the small plant lice or aphids which are prevalent on nearly every garden plant during the summer.

TWO OTHER insecticides from plants, are widely used to kill piercing-sucking insects and also for those chewing insects which are feeding on plants that will soon be used as food and consequently must not be sprayed with the stomach poisons—lead arsenate or cryolite. These valuable materials are, first, *pyrethrins* secured from the flower-heads of certain chrysanthemum plants grown mostly in Japan, East Africa and Southern Europe. The second is *rotenone and rotenoids*, extracted from the roots of certain tropical trees and plants, known as Derris, Timbo and Cubé. Both pyrethrins and rotenone have the marvelous property of being deadly to insects but entirely harmless if swallowed by man; so they can be applied liberally to any kind of plant and will kill most insects hit by the spray or dust, and will not leave a harmful residue on the plants. The only unfortunate thing about these insecticides is that they are very unstable compounds and, unless they are kept very tightly boxed until ready to be used and applied within a year of manufacture, they are likely to be ineffective. In purchasing pyrethrum and rotenones get the product of the most reliable companies, have your dealer's assurance that it is fresh stock, and do not try to keep a supply on hand for more than a few weeks.

The war has created a serious shortage of both of these insecticides. Our supply of pyrethrum from Japan was cut off in August, 1940; and it has become difficult to get from Kenya Colony, in East Africa, the thousands of tons needed annually in the United States. Formerly the most important source of rotenone was the roots of Derris trees, imported from the Philippines, from Malay and the Dutch East Indies. During the war we shall be dependent for rotenone upon two South American sources. In Peru a cultivated shrub, *Lonchocarpus utilis*, the roots of which are marketed under the name of Cubé, is a very

valuable source of this insecticide. It requires 2 to 4 years to grow a crop. In Brazil, along the Amazon River, a tree that grows wild, in the same general area as the rubber trees, and is cultivated to some extent, *Lonchocarpus urucu*, also has rotenone in its roots. Because of labor and shipping difficulties, there is likely to be a serious shortage of both pyrethrins and rotenones during the war. We should use the available supply with the utmost economy and efficiency and by no means try to hoard supplies for they will become useless in long-time storage.

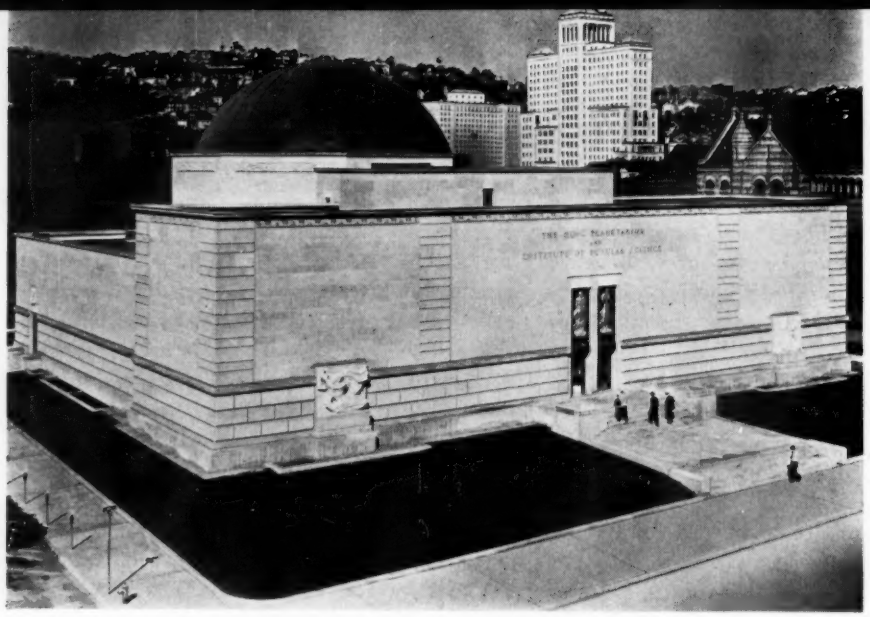
PYRETHRINS and Rotenone can be applied in the same manner as nicotine, to cover the bodies of any insect pests with a spray or dust. The rotenone must never be mixed with lime which destroys its efficiency. Since all of the stomach poisons and contact insecticides are costly to produce, and many of them are sure to be subject to serious shortage, it is very important that all of us be careful to select the right materials for the particular insect attacks that occur on our crops. I hope that the general rules I have given will be helpful; but any citizen who needs help to decide what spray should be used to control a particular insect, without injury to the special crop being attacked, is welcome to advice if he will send a few speciments of the pest in a firm tight box or vial, to the Department of Entomology at the University of Illinois, with as full a statement of the conditions of attack as possible.. For aphids, asparagus beetles attacking the edible young shoots, for cabbageworms, Mexican bean beetle, and similar pests on food plants, a dust containing three-fourths of one percent rotenone or one- tenth per cent pyrethrins will be very effective. For the tough squash bug two-tenths per cent pyrethrins will be necessary. The finely ground fresh roots of Cubé or Timbo may be mixed in water at the rate of one ounce to the gallon with a tablespoonful of fine flour or other good sticker, to make an effective spray.

AN EXCELLENT preventive cover spray that will protect plants from chewing insects and also from many fungous diseases and which is also effective in repelling such pests as leafhoppers and flea beetles, is Bordeaux mixture. It is the nearest thing to a complete spray that I know about. Since much of the expense of spraying is invilved in applying the chemicals, it is economical, whenever practicable, to use such combined sprays. This one consists of a stomach poison, a fungicide and a repellant; and, if aphids are present on the crop to be sprayed, a contact insecticide, such as nicotine sulphate may be added.

Bordeaux must be made up fresh, just before applying. The necessary ingredients are copper sulphate (also called bluestone or blue vitriol), fresh stone lime, pebble lime, or hydrated lime, (air slaked lime will not do) and cold water. Warm water will not do; use the coldest water you can get.

THE COPPER sulphate should be dissolved in water in a wooden or earthenware vessel (not metal); the lime carefully slaked and mixed with water; then all of the water to be used should be mixed with one or the other or both of the chemicals, before the lime and copper sulphate are brought together. Then stir the chemicals vigorously as they are mixed together and you will have a beautiful blue suspension of basic copper sulphates that will form a valuable protective coat over the plants as the spray dries. To simplify the mixing, since this spray should be applied about every ten days to keep new growth covered, I like to make stock mixtures at the beginning of the season, enough to make all of the spray needed for the next several months. On a scale adequate for most gardens, dissolve 2 pounds of copper sulphate in ½ gallon of hot water and divide this into six equal parts in tightly closed fruit jars or bottles. Slake 2 pounds of stone- or pebble-lime in ½ gallon of water and divide it into six equal parts also sealed in fruit jars. In this way the chemicals will keep indefinitely. Then, any time you wish to spray with Bordeaux add the contents of one of the jars of copper sulphate and one of the lime to 5 gallons of cold water, stirring vigorously; and if you wish to apply the stomach poison and the contact poison, also, next stir into the mixed Bordeaux, 2 ounces of lead arsenate for chewing insects and one

Continued on page 27



Buhl Planetarium. Science Teachers meet here July 4 with N.E.A.

PROGRAM

N. E. A. Departmental Meeting for All Science Teachers

PITTSBURGH, JULY 4, 1944

Morning Session—9:45 a.m.

(Place of meeting to be announced)

"Rebuilding With Science" . . . Emil L. Massey, Director of Science Detroit Public Schools

"Our Native Land and Its Natural Resources" Dr. E. R. Martel, Purdue University, Layfaette, Indiana

"Science Developments that All Science Teachers Should Understand" . . . Miss Bertha E. Slye, School Service Westinghouse Electric & Mfg. Co. Pittsburgh, Pennsylvania

Business meeting: reports of officers, committees, etc.

Afternoon Session—1:15 p. m.

*Buhl Planetarium (Air-Conditioned)**

1:15— Main Galleries
Exhibitions of Science Displays

1:45— Lecture Hall
"Influence of War Research on Post-War Science Training" . . . Dr. Alexander Silverman University of Pittsburgh

"Army Needs As They Relate to Science . . . . Lieut. Daniel C. McNaughton War Department, Washington, D. C.

The National Science Teachers Association . . . . Dr. Philip G. Johnson and others

Business meeting (continued)

3:15— Lecture Hall, Star Theater, etc.
New Science Demonstrations—Buhl Planetarium Staff

4:15— Lecture Hall
Science Films, prepared and shown by School Service, Westinghouse Electric & Manufacturing Co.

Buhl Planetarium invites all representatives to view its 50-minute Sky Show starting at 8 p. m. *(See notes at bottom of next page.)*

INSECTS IN WARTIME

Continued from page 25

or two ounces of nicotine sulphate for aphids; and you will have a very effective, complete, protective spray.

Every grower of crops should have available an efficient spray pump or dust gun, or both; adequate to protect the acreage and kind of crops he expects to grow. The growers of small Victory Gardens should probably pool their interests and make one set of equipment serve several gardens. Since many insects feed only from the under surface of the leaves, sprayers should be equipped with a right-angle elbow next to the nozzle to make it possible to cover the under surface of the plant leaves.

FOR THE subterranean pests such as white grubs and the grubs of the Japanese beetle, lead arsenate may be washed or drilled into the soil, using one to three pounds for each 100 square feet of soil. Or a fumigant, made by emulsifying carbon disulphide, may be sprayed over the infested ground and will soak down and poison the soil insects.

During the next few years it will be important to do all we can to control insects by mechanical and cultural measures and so conserve the supply of insecticides. For example, these white grubs and the equally destructive wireworms can often be eliminated from small areas by burying bunches of fresh-cut clover, sliced potatoes or seeds such as beans or corn that have been started to germinate by soaking in water, two to four inches deep in the soil, at intervals of 4 or 5 feet, marking the spots, and digging them up a week or so later and killing sometimes hundreds of the worms that have collected about them.

A very helpful practice in avoiding destructive attacks by insects is clean farming. Keeping down the weeds both in the fields or garden and in the margins and on adjacent lots, will help greatly to prevent attacks of such pests as flea beetles, the common stalk borer, and armyworms, which develop in the weeds before the gardens are planted and then invade the cultivated crops.

THE PROMPT destruction of all crop remnants just as soon as the major part of the crop has been harvested is very important in reducing the number of pests for the following year. Cabbage stalks should be pulled up and detroyed as soon as the heads are removed. The vines of melons, cucumber, squash, pumpkin, and tomatoes, as well as any unripe or rotting fruits, should be raked together and burned or converted into compost by burying deeply in the soil, just as soon as most of the fruits have been harvested in order to destroy vine borers and not to leave the vines and old fruits to feed the aphids, squash bugs, cucumber beetles, tomato worms and other pests during late fall days and fatten them up for most succesful wintering.

The clean-up of general trash such as boards, boxes, sacks, fallen leaves, piles of brush, and other litter, is also helpful in reducing the numbers of certain garden and crop pests that may successfully winter.

SOMETIMES in small gardens, the cheapest and most effective control of pests is hand picking and crushing. This may be used very effectively for the big green hornworms of tomato plants, if the gardener will watch his plants carefully and look also for their pellets of excrement on the leaves or on the ground—which are often more easily seen than the worms themselves. By the way you need not be afraid to pick off these worms, for the sharp thorn at the tail end of their bodies is perfectly harmless. The eggs of the squash bug are laid in groups of several dozen on the under side of the leaves of the cucurbit

Continued on page 40

In order to assure a good representation, science teachers are urged to contact their local, district and state association officers in an effort to secure an appointment as an official delegate to the N.E.A. Representative Assembly. Then plan trip so as to arrive for our meeting on July 4.

*Buhl Planetarium, Federal and West Ohio Streets, Pittsburgh, is 7 minutes from Headquarters. Take No. 22, Crosstown, street car from any place on Fifth Avenue. Get off at Ohio Street.

Science Clubs at Work

Edited by DR. ANNA A. SCHNIEB

State Teachers College Richmond, Kentucky

• A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Schnieb.

The Kentucky Junior Academy Science

THE KENTUCKY Junior Academy of Science is now in its eleventh year. It has grown steadily in membership and in quality of work. The greatest improvement has been made in the articles published in the *Junior Science Bulletin*, official publication of the Junior Academy. The articles have become less and less of the library type and more and more of the laboratory and field trip study. Generally speaking, the members agree with John Locke when he says: "I can no more know a thing from another man's understanding than I can see with the other man's eyes." The problems and the projects are not selected from some suggested list. They grow out of local conditions, interests, and needs which is shown by the accompanying articles. A close relationship exists between the club activities and the local community which has done much in establishing a consciousness for science.

The members consider the *Junior Science Bulletin* a valuable asset. It is published for and by the junior members, it carries no advertising and it is issued regularly. They consider it a great honor to have articles published in their periodical. Improvement in the *Junior Science Bulletin* together with the work in the Kentucky Ornithological Society have been the outstanding achievements for the year.

Problems Studied by Limestone Science Club

(See picture on following page)

TANDY CHENAULT, Sponsor

Maysville High School Maysville, Kentucky

Four problems are here represented in picture:

1. How water may be purified by distillation which is shown in the picture by the boy and girl seated at the first table. The results of their experiment are being tested by the two girls standing at the rear window. They found that impurities were wholly absent after the fifth sample was tested.

2. To understand the Law of Moments which is shown by the two boys seated at the center table. They are trying to determine that the product of the lever arm times the force acting upon it is equal to that of the other lever arm. The results were satisfactory.

3. To understand the functions of the heart, ear, and eye through the use of models. The models are being studied by the boys seated at the table in the rear right hand corner. They are trying to verify their reading with their observations.

4. To understand the preparation and the chemical properties of sulfur dioxide gas which is shown by the four students standing at the table in front of the right window. Their experiment was carried out satisfactorily. Some errors were noted caused perhaps by the use of old chemicals, new ones not available, and leaks caused by loose fittings.

The Limstone Science Club has thirty-eight members. It is affiliated with the Kentucky Junior Academy of Science and with the Kentucky Ornithological Society. Several of the members are applying for a bird-banding permit which has resulted from many excellent bird observations. The club was named in honor of the very extensive layer of limestone in the Maysville area.

Through the very able leadership of the sponsor, Mr. Tandy Chenault, the club illustrates well how individual differences may be recognized in any club as well as in the high school.

Students in club work studying distillation of water, the law of moments, the functions of the ear and eye, and the properties of sulfur dioxide gas.

A Tyrant of the Air, the Kingbird

JAMES O'BANNON
Student
Paducah High School
Paducah, Kentucky

THE KINGBIRD really deserves the name of tyrant. He is constantly chasing crows, hawks, and other birds. He dives and darts around the heads of these birds until they leave the neighborhood.

The kingbird is about eight inches long, pale slate-colored with dirty gray underparts. Its tail is almost black with a broad band of white. The adult birds have an orange-red patch on the crown.

Kingbirds belong to the group of flycatchers. They are well suited to the work of catching insects on the wing. Their bill is wide at its base and has a small curved clasp on the end. Around the base of the bill are stiff bristles to help hold the insects.

THE KINGBIRD picks a favorite perch in a neighborhood and may be frequently seen at that perch, always on the alert for insects. When it sees an insect, it dashes off and catches it. It has been estimated that a kingbird can see an insect at one hundred feet.

The kingbird has no crop. His food is swallowed directly into the stomach. He feeds largely on insects, and since the exoskeletons of the insects are indigestible, they are rolled into little pellets which are disgorged from time to time.

The nest of the kingbird is built about twenty feet from the ground. The nest is large but compact and it is usually made of some wooly material.

The eggs are laid in May and number about five. They are white with brown spots, especially around the larger end.

MANY people call the kingbird the bee martin. To find the truth in this, some scientific men in Washington, D. C. recently gathered over two hundred kingbirds from all over the country. In only fourteen stomachs did they find bees, and these were drones. Indeed, it is the wise apiarists who welcome kingbirds. They destroy robber flies which are pests to the hive.

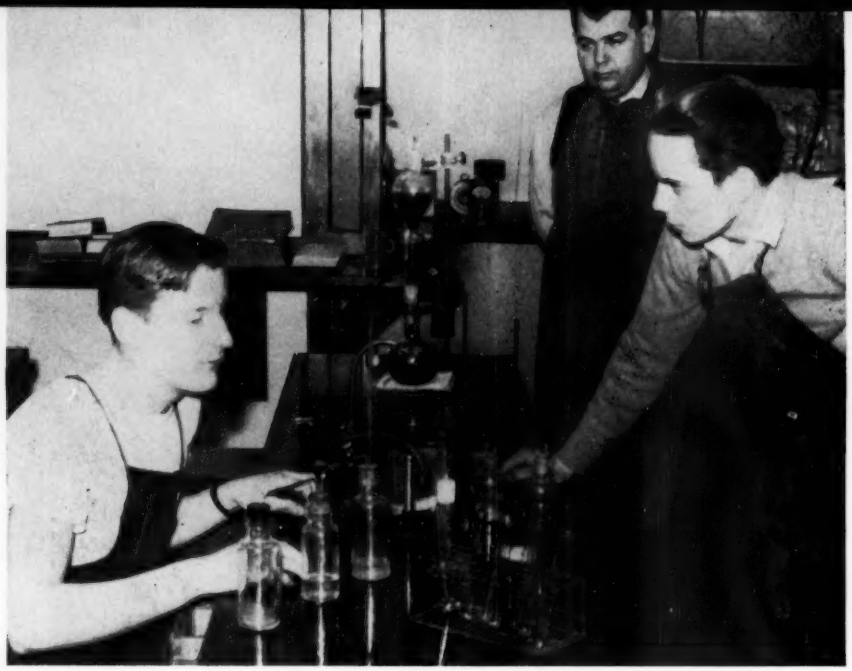
References:

BRALLIAR, FLOYD. *Knowing Bees Through Stories.*

ASHBROOK, FRANK G. *The Blue Books of Birds of America.*

★

War Crops. A 4 page folder, 8½x11 inches. Deals with producing rubber in Central and South America. Reprinted from American Magazine, October, 1943 issue. Write to Middle America Information Bureau, 9 Rockefeller Plaza, Suit 224, New York 30, New York.



Collecting and testing chlorine gas in club work.

THE PICTURES represent regular science club work of the Sperti Club. They were taken, developed, enlarged, and printed by members of the Sperti Club.

The Sperti Club has fifty-seven members. It is affiliated with the Kentucky Junior Academy of Science and the Kentucky Ornithological Society. It was named in honor of Dr. George Sperti, a distinguished young scientist and a native of Kentucky who has done outstanding work on burn treatment and cancer.

At the present time, the club is preparing a scientific demonstration to be presented before the Ft. Thomas High School Assembly and at the annual meeting of the Kentucky Junior Academy of Science to be held in Lexington, Kentucky, April 14 and 15. One member has been asked to address the convention which will take the place of one of the usual guest speakers, and other members are planning to compete for the Discussion Award.

Mr. Austin Durham is sponsor of the club.

Studying the effects of static electricity.

Planning a science club program.

An Educational Films Program in the East St. Louis Senior High School, East St. Louis, Illinois

J. W. GALBREATH

East St. Louis Senior High School — East St. Louis, Illincis

VII. Report of Film Use

THIS REPORT must be completed by the department committee member and returned to the director by the end of the last showing. The card form used is duplicated here in full.

RECORD AND REPORT OF FILM USE

(To be filled in by used of film and filed for future reference)

1. Title of film.....*The Nervous System*.....
2. No of reels..... Silent or Sound?.....*Sound*.....
3. Name of Teacher..*Ellington*.. Subject..*Biology II* Grade....*10-2*.....
4. Date film was shown..*1-43*.. Room shown in..*112*
5. This film suitable for Unit on....*Behavior*,... *Nervous System of Man*.....
6. Strong points of film.....*Structure and Function of Central Nervous System*.....
7. Weak points of film.....*Sequence too rapid*.....
8. Observations and remarks....*Good summary film*
9. Total number in attendance....*142*....
10. Number of times shown....*5*.. Semester total..*652*..

VIII. Annual Report for Current Year 1941-42

This report, which is duplicated here in full, serves as a guide for the future, as a report to the principal and other interested authorities.

EAST ST. LOUIS SENIOR HIGH SCHOOL
East St. Louis, Illinois
June, 1942

ANNUAL VISUAL EDUCATION REPORT
School Year 1941-42

I. 1941-42 Summary
- a. Grand total number of film titles shown for the year..... 238
- b. Grand total number of reels shown.... 318
- c. Grand total number of times above reels were shown.....1400
- d. Average number of times each reel was shown..... 4.43
- e. Average rental cost per reel to school...538¢
- f. Average projection cost per reel to to school.....305¢
- g. Average total cost per reel to school...843¢

II. Expenditures for film program.
- a. Total Film Rentals.....$112.10
- b. Total Transportation..... 59.08
- c. Grand total for films (a+b).....$171.18

III. Total projector supplies and repairs.....$ 97.11

IX. Financing the Program

THE ORIGINAL equipment was purchased out of the athletic funds. Maintenance of of equipment, film rentals, transportation charges on films, and incidental costs have been provided by the Board of Education, an annual movie pay-program, and from the general school fund. These costs have not been great as you can see from the annual report.

X. The Correct Use of Educational Films

Since the author believes that too many "movies" in the class room hastens the death of any educational film program, much emphasis has been placed on the correct use of the educational film. In order to illustrate the exact purpose and use of a specific film, the following "Teacher's Manual and Lesson Plan" on the film "Foods and Nutrition" is given here:

Teacher's Manual and Less Plan on the educational film "Foods and Nutrition"

Best Use:

Review of the unit: Food, Nutrition and Growth. Teach: Life Processes in Man.

Objectives:

1. Nutrition plays an important part in intelligent and healthful living.
2. The ultimate source of all energy is the sun.
3. The rate of metabolism increases with the rate of activity.
4. The proper selection of kinds and amounts of food plays an important part in a healthful diet.
5. Protein is essential in the production of protoplasm in the cell.
6. An important step toward wise food selection is the development of a critical attitude toward food advertisement.

Content:

1. Introduction.
   Proper nutrition plays an important part in the intelligent and healthful living of man. It is high time that the average person gain certain fundamental information of diet pertinent to living a long, happy, healthy and useful life.
   It is a common fact that even though there is plenty of food in America, a large percent-

age of the people are not properly fed. (About 50%.) Today we know that certain foods contain various nutrients which serve specific function to our body.

Improper diet is largely a matter of ignorance. It is an important business of science to see to it that each individual in America applies the present knowledge of food and nutrition in developing a healthier body, increased vigor, a long and happier life, and thus acquiring greater chance for higher achievement in living.

2. Classes of foods
   a. Carbohydrates
   b. Proteins
   c. Fats and Oils
   d. Minerals
   e. Vitamins
   f. Water

   Give the sources, uses, and the result if lacking in the diet of these classes. (Many tables to be found in biology textbooks will supply this information and the teacher may well place such a convenient table on the board. For best results this material should be carefully studied before the film is shown.

3. Sequence of events in film.
   a. Man and his food requirements.
   b. Digestion, absorption of sugars, and formation of glycogen.
   c. Digestion, absorption of fats (also in hogs.)
   d. Use of foods, metabolism, exercises, need for oxygen.
   e. Method of determining the rate of metabolism, oxygen used and CO_2 exhaled.
   f. Temperature, height, weight, activity and age are factors.
   g. Protein necessity of cell for growth cow, rats, amino acids, urea.
   h. Mineral requirements, blood, anemic rate, mineral defiicent rat.
   i. Vitamins, sources, whole wheat, fruits, deficiency diseases in rats, pigeons, and child. Scientific guides to eating, hunger, appetite. Stomach reaction to food.
   j. Market showing fruits and vegetables.
   k. Results of proper nutrition; growing old gracefully, aged man playing tennis, contentment.

4. Testing Results
   a. How does temperature, activity or occupation, age, weight, and height determine the amount of food required?
   b. How does temperature, activity or occupation, age, weight, and height determine the kind or class of food required?
   c. Develop a definition of a food.
   d. What determines the rate of metabolism?
   e. Give some examples of food advertising. Are they based on facts? Explain.
   f. State and explain some principles of sound nutrition.
   g. What social problems arise from improper and inadequate nutrition?
   h. Explain how beefsteak's ultimates source of energy is the sun.
   i. Why is it not wise to overeat?
   j. Name the six classes of foods and give some examples of each class.

   Where does this film help to teach the following principles:

   "The ultimate sources of all energy is the sun."
   "The rate of metabolism increases with the rate of activity."
   "Protein is essential in the production of protoplasm in the cell."

Criteria for the Evaluation of Educational Films in Biology

1. Does the film assist in developing an understanding of one or more important biological principles?
2. Does the film contribute to the development of one or more important scientific attitudes?
3. Does the film assist in developing one or more elements in the scientific method?
4. Does the film stimulate the asking of questions which will encourage reflective thinking?
5. Does the film stimulate interests which may develop into worthwhile hobbies?
6. Does the film add to an aesthetic appreciation of nature by instructing in:
   a. The charm and beauty o fthe great out-of-doors.
   b. The mystery of growing things.
   c. The joy of association with wild life.
   d. The law and order in nature.

The objectives here are stated as biological principles. The introduction and film content are given to the class prior to seeing the films. After the film presentation results were tested by asking questions on the content.

The "Criteria for the Evaluation of Educational Films" is included here as a guide in selecting, using, and evaluating films for biology classes. These "Criteria" are also used by other departments.

XI. General Conclusion.

THE AUTHOR feels that the following objectives are being met by our use of educational films:

That subject matter has been enriched through the varied experience that the educational film adds to the regular curriculum.

That subject matter content has not only been enriched but new materials have brought to the classroom current materials on present world conditions which have aided the students in properly interpreting present world affairs.

That progress in the use of newer methods of educational technique have added professional growth and zeal to teaching.

That through continued effort of striving toward the best methods of film use, they have won a coveted place as a modern tool in efficient and effective classroom instruction

COUNCIL NOTES

Continued from page 11

NEW AFFILIATIONS

Two former groups of science teachers of Central California have recently reorganized as the *Central California Council of Science Teachers* at their meeting of February 25. They voted affiliation with the American Council of Science Teachers. Mr. Henry R. Jennings of the Piedmont High School of Commerce, San Francisco, was elected president.

The *Science Section* of the *Central Division* of the Illinois Education Association, meeting at Normal, Illinois, March 6, voted affiliation wth the American Council. Dr. Nina Gray of Normal University, was selected as president.

Yearbook Committee:

Nathan A. Neal, Board of Education, Cleveland Ohio, Chairman
Dr. Will Burnett, Stanford University, Stanford University, California
Dr. Paul M. Kambly, University of Iowa, Iowa City, Iowa
Miss Marie Knauz, Peabody High School, Pittsburgh, Pennsylvania
Mr. W. L. MacGowan, 3212 Park St., Jacksonville, Florida
Mr. T. A. Nelson Lyon's Township High School, LaGrange, Illinois
Mr. Lester R. Williard, 209 Grace St., Roselle, New Jersey

Resolutions Committee:

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Mr. W. Bayard Buckham, 50 Buckeye Ave., Oakland, California
Dr. Charles U. Cross, University of Arkansas, Fayetteville, Arkansas
Mr. J. W. Galbreath, 2558 Forrest Place, E. St. Louis, Illinois
Mr. Don Gordon, 528 E. Astor, Colville, Washington
Mr. Franklin Mathewson, 15 Southminster Drive, White Plains, New York

Nominating Committee:

Miss Anna E. Burgess, Miles Standish School, Cleveland, Ohio
Mr. W. D. Bracken, High School, St. Joseph, Missouri
Mr. John C. Chiddix, Community High School, Normal, Illinois

HAVE YOU SEEN THESE MATERIALS?

A. *A Course in Practical Gardening for Boys and Girls* written by Paul R. Young, Supervisor of Gardening in the Cleveland Schools. There is a teacher's manual too. This is a project type of course for elementary school pupils. These materials are available from Garden Reviews, Inc., Pleasantville, N. Y.

B. *The Romance of Electricity.* In 56 pages. This tells the story of developments in electricity in an interesting and elementary manner. You will like it and so will many of your pupils. It's a February release by General Electric, Publicity Divisions, Schenectady, N. Y.

C. *Airplane Power.* (Revised Edition.) An 88 page booklet written for employees in industry but of interest to pupils and teachers in the sciences. There are many clever illustrations. Get it from General Motors, Detroit (2), Mich.

D. *Maps—How to Understand Them.* This is a 32 page booklet on maps related to our globe. It's really very good for pupils and teachers. Secure your copy from Consolidated Vultee Aircraft Corp., P. O. Box 157, New York, N. Y. You may also be interested in Cram's U. S. Centric World Map distributed by the George F. Cram Company, Indianapolis 7, Ind. The literature is free but the map is $12.00.

E. *Ashes Make Your Gunpowder.* A general booklet on fire insurance that does not mention any specific company but it does call attention to fire hazards in wartime. Distributed by The National Board of Fire Underwriters, New York, Chicago, or San Francisco.

F. *Aviation Manual for Junior and Senior High Schools.* This contains 51 pages of very helpful information about aviation in general and aircraft developments in

Continued on page 34

particular. You certainly should get it from United Air Lines, Chicago.

G. *A bibliography of Literature and Visual Aids for the Study of Our Forest Resources and Their Conservation.* This lists booklets, maps, posters and a motion picture related to forest conservation. Address American Forest Products Industries, 1319 Eighteenth St., N. W., Washington, D. C.

H. *Pre-Induction Training in Health, Sanitation and First Aid.* This is a brief report on the work done by a committee of biology teachers working in cooperation with the U. S. Office of Education and the Pre-Induction Training Branch of the War Department. Read it in Education For Victory, Jan. 3, 1944.

I. *The Science Yearbook of 1943.* Here is a book containing reports on science developments for 1943. The really good science articles from The Saturday Evening Post, Collier's, Harpers, etc., are there together with an introduction about synthetic rubber. There is a similar book published for 1942. Your school library should have both of them. Published by Doubleday, Doran & Company, Inc., Garden City, N. Y. at $2.50.

J. *Textile Identification Unit.* Is your school or your science department a subscriber to THINGS of Science? If not, this should be true because from time to time during the year you get these units of real materials for use with your pupils and for addition to your science museum. One year membership, composed of 12 different units is $4.00. Nine monthly units are $3.00 and six units $2.00. This is cheap, considering what you get. Send your order to Science Service, 1719 N. Street, N. W., Washington, D. C. While you write, send 25 cents for *Science and the Future;* the essays written by future scientists for the 2nd annual Science Talent Search.

K. *The Story of the Turbine.* A 24 page pamphlet which discusses the structure and operation of steam turbines. The text is clear and concise and the illustrations are excellent. Get your copy from the General Electric Company, Publicity Division, Schnectady, N. Y.

★

WRITE FOR IT

Bibliography of Economic and Social Study. 30 page booklet. Lists some films of general interest in science. The National Association of Manufacturers, 14 W. 49th Street, New York City.

★

EFFECT OF PRESSURE

Continued from page 15

graph paper, instead of using standard cross-ruled paper.

The equipment requires only two flasks, two burette clamps to hold the flasks, one ring, two rubber stoppers to fit the flasks and a thermometer. This is not much equipment to set aside for an experiment of this kind. Since all the connections are air tight, and quite permanent the apparatus is always ready for operation. This surely is a help for the busy science teacher.

List of Materials

Base Board 7½x¾x18 inches
Manometer Board 3x¾x31 inches
Strip of Wood 1x1½x18 inches
Dowel Rod ½x24 inches
Carriage Bolts 2—⅜x10 inches
1—⅜x 6 inches
Stove Bolts 2—3/16x1½ inches fitted with wing nuts
Yard Stick cut to 30 inches
Meter Stick cut to 75 centimeters
500 watt heating unit (used from old cooking utensils, furnished by the pupils in the class

Laboratory Materials

1—500 cc. Flask
1—250 cc. Flask
2—Rubber Stoppers, two holes to fit flasks
Glass Tubing
1—T Tube
Rubber Tubing
1—Thermometer graduated in Centigrade and Fahrenheit Scales
1—Small Dish to hold mercury.

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Continued from page 21

to make and improve hand spinning wheels. At the same time, however, efforts were made to obtain a suitable type of equipment which would produce yarn of a quality to compare with the yarn produced by the larger factories. From India, where such equipment existed for cotton, a set of machinery was imported. Copies are being made. It consists of the complete equipment for cleaning and preparation of the cotton, and includes a spinning unit of 250 spindles. Wool industry developed in similar fashion. The Indian or Ghosh spinning factory, utilizing an English wool unit, employs thirty people, or, working two shifts, sixty people.

A GOOD deal of work is being done along similar lines for the production of paper and soap and in the tanning of leather. In the case of paper, you may be interested to know that by chance I saw a paper beater in the Dodd-Hunter Museum in Cambridge which seemed to me ideally suited for China. It was one of the earliest types of paper beater used in this country. I had drawings made and sent to China. We hope soon to hear that they have this machine in production.

The machine shops are being developed as rapidly as possible. They are making their own lathes, drill presses and shaping machines. Plans are being sent out, as fast as we are able to obtain them, of simple types of machinery and equipment which will be useful to them.

THE CHINESE have to make their own tanning material. This has meant experimental work in the three chemical laboratories connected with the Chinese Industrial Cooperatives, aided by considerable help from New Hampshire University. In conjunction with the canneries, they are making use of bones to extract the phosphorus and, in some cases, we understand, ammonia too. The refuse is converted into fertilizer. Ammonia is also being recovered from urine.

It is obvious that, in setting up these industries, it is essential to have industrial schools. Rewi Alley, who has been the organizing genius behind the Chinese Industrial Cooperatives from the beginning, considers the technical education to be the real basis on which everything depends. For this reason, a great deal of attention has been paid to the setting up of schools. There are now three Bailie Schools; and they have so far turned out about 150 trained textile people, accountants, mechanics, etc. The schools are training workers in paper making, dyeing, soap making, truck maintenance and repair, charcoal burning, mining, textiles and accounting. They run in conjunction with the cooperative workshops so that the boys get practical training in the things in which they intend to specialize.

THE PROMOTION of the cooperatives may be said to be in the hands of two groups. One is the International Committee which coordinates the help from England, America and other countries and has its own technical and servicing department. Rewi Alley is Chief Advisor to this committee. There is also the Association for the Advancement of Chinese Industrial Cooperatives, the Chairman of which is Dr. Kung. These two groups, besides planning and promoting the cooperatives themselves, give assistance to the Bailie Schools for the training of workers, to the carrying on of experiments on processes and equipment, and give help to the local federations on their problems of organization, finance and accounting.

The technical problems that face the cooperatives are greatly complicated by the fact that it is now impossible to send anything to China. Therefore, in planning for any equipment, it is necessary that the design be such that it can be made with the very limited facilities at their disposal. One must also take into account the fact that most modern equipment and most modern processes are designed for large scale factories, so that in many cases it is extremely difficult to obtain suitable processes and suitable designs for use in small scale industry in China. The method that we have adopted is, by and large, to go back to the methods used fifty or one hundred years ago in this country or Europe, and then have these methods checked by experts in their respective fields. In some cases, on the other hand, processes that are being developed today may have immediate application to China.

Probably the most dramatic is the case of penicillin. Crude penicillin can easily be made in China. Pure penicillin can probably be made, too, with only very simple modifications of the process used in this country. For example, instead of using an autoclave to sterilize the bottles, this can be done by placing them in a brick oven. Instead of using an expensive kettle, in China they would probably use a gasoline drum.

SPONGE iron manufacture presents a particularly interesting case. First made in China a thousand years ago, sponge iron is still made by the same primitive methods. In China, they take the iron ore which is in the form of a sand and place it in layers in a crucible, alternating each layer with one of ground charcoal. The crucible is covered and placed in a brick kiln where it is heated for several days so that the carbon can obsorb the oxygen from the iron. After cooling down, the crucibles are broken open, leaving small slabs of sponge iron. This process is fundamentally the same as the one used in Sweden for producing the best Swedish steel, and has been used in this country with various modifications. We have had the process worked out in detail for a ton plant, the particulars of which have been sent to China. The chief difference between this and the original Chinese method is that our revamped process uses a certain amount of machinery, of the type that can be made in China. Among these are stamps or ball mills for grinding the ore or the charcoal, magnetic separators, and similar equipment. The principle is exactly the same. It may interest you to know that I heard only yesterday that the process that was worked out by us for use in China has actually been put to work in Mexico, and is producing a very excellent iron. This, to my mind, is extremely interesting, as it is an instance of a process which can produce efficiently on a small scale. There are likely to be further developments in the sponge iron process, and these will probably be much more elaborate, as they will involve the use of hydrogen as the reducing agent. In order to affect the reduction, a temperature of 1100 degrees Fahrenheit has been found satisfactory. This new process is automatic and continuous, and can be stopped at will as there is no question of molten slag or metal involved. It can produce a very high grade product economically. Machinery of this kind may have a very great influence on the kind of industrialization which will finally be adopted in China. It points up one of the problems which needs the serious consideration of scientists. It is an examination of the smallest units in any particular industry that can be worked efficiently and produce high grade products comparable to those of large scale industry.

THE QUESTION of whether China wishes to avail itself of the advantages of developing small local industries is, of course, a political problem, and depends on the kind of industrialization which is likely to take place. As far as one can see at present, there will be two distinct trends in the industrial development of China after the war. One is the development of large American style industry with the intervention, in many cases, of the government. If one examines the reports of engineers and students who have been sent to this country to make studies for the post war reconstruction, it is obvious that they think in terms of large scale American industry. However, there is a feeling amongst some of the economists that they would like to try to avoid some of the difficulties which have been caused by this kind of centralization of industry and population; and so they welcome the ideas advanced by the people connected with the Chinese Industrial Cooperatives as complementary to the American method. Whatever the method or methods adopted, the work being done by the cooperatives will be of immense value. It is preparing people to think in terms of intergrated planning. It is training technicians with a thorough practical grounding so that there will be people familiar with the technique of various industries. By making these people accustomed to work in a cooperative way, they are laying the seed for an organization which may cover the whole of China and integrate all phases of activity. It is important to China that there should be people capable of planning along these lines, people who can see the importance of develop-

Continued on page 42

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INSECTS IN WARTIME

Continued from page 27

plants and by looking over the leaves at intervals, the gardener can often destroy dozens of these bugs before they acquire legs and wings, by a mere squashing between thumb and finger. Leaves which show the white lines made by the tunneling of leaf miners may well be picked off and burned.

Some of the borers that tunnel through plant stems may be destroyed by carefully splitting the stem lengthwise with a sharp knife, crushing the worms and replacing the split parts, covering squash vines with moist soil or perhaps wrapping plant stems with a bit of cellophane tape. If you can find a hole through which the borer is casting out frass from its tunnel, a very effective way to kill it is to squirt a few drops of carbon disulphide into the burrow through this hole from a medicine dropper or oil can, and close the hole with a bit of putty or chewing gum. The heavy poison gas formed by the carbon disulphide will penetrate along the burrow and kill the worm, without injury to the plant.

Other important methods of making our applications of insecticides effective, and avoiding waste, are to know and observe the minimum dosage that can be depended upon to destroy the pests.

And the proper timing of the applications is extremely important: In general, young insects are easier to kill than the old tough ones, so growers should be constantly on the watch for insect invasions or outbreaks and check them with the proper sprays, dusts, poison baits or mechanical measures, before serious damage has been inflicted and the bugs have become older and harder to kill.

Thoroughness of application is also of the utmost importance. Stomach poisons must cover every bit of leaf surface, stems and fruits. Contact poisons must hit every tiny bug present with a bit of the spray or dust. In both cases it is especially important to cover the under sides of all leaves where so many of the pests stay and feed.

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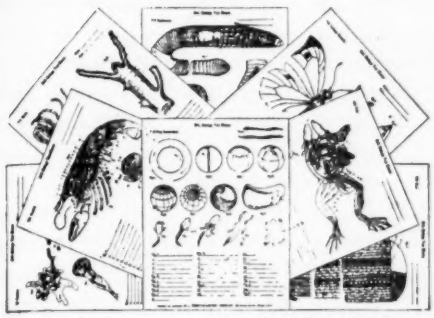

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T40 Aortic Arches of Vertebrates.
T41 Dogfish.
T44 Perch.
T45 Perch Skeleton.
T46 Frog Brain.
T47 Frog Urogenital Systems.
T48 Frog Development.
T49 Frog Anatomy.
T49a Frog, ventral dissection showing muscles and internal anatomy.
T50 Frog Skeleton.
T57 Bird.
T60 Cat Skeleton.
T75 Cell Division.
T76 Spirogyra.
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IN CONCLUDING this article on The Importance of Insects to a Nation at War, and What We Can Do About It. I want to stress the fact that everyone of us can perform a real service to our country, as civilians on the home front, which is always an insect battlefront, and help to "keep 'em rolling," by being on the alert to detect insect outbreaks; either the landing of hordes of parachute troops, or the sneaking advent of a 5th columnist, here and there, in our homes, our gardens, our barns, orchards, fields and woodlands.

And may I point out how vastly more potent are the insect 5th columnists or reconnaissance planes, than human spies: because each one, if not intercepted and destroyed, may in a few months be the mother and progenitor of literally millions of insect troops. For the insects take advantage of the fact that females can do everything as well as males and in addition can, in many insect species, be mothers of hundreds of other females without even seeing a male.

OUR WARFARE against the bugs must not be merely a delaying action, designed to gain time, for the insects lead such a fast life that 10 days to 6 weeks may enable them to accomplish what takes us 20 to 30 years to do.

May it, then, be all-out warfare against the destructive insects this summer; and may I pledge to each of you the willingness *and the desire* of all official entomologists to be of the greatest possible aid to you, when and if you need professional advice.

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CHINA IN RECONSTRUCTION

Continued from page 38

ing the country in such a way as to benefit every locality.

IN DISCUSSING the question of the industrialization of China in general, it is my opinion that all the Chinese are united in one thing, and that is that they do not want foreign powers to get control of China's economic life. As foreign powers began to invade China, China's unity rapidly expanded and took in the whole country. The present war has certainly shown how effective this unity can be. The different factions in the Kuomintang, because of the common determination to stop foreign exploitation or domination, whether it be by Japanese, British or Americans, have been able to keep together despite many forces which have tended to separate them into groups. The Chinese developed their civilization long before any of us; and they feel perfectly capable of carrying on by themselves.

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Everybody in China wants to industrialize. They want to produce the things that make life easier. They want schools and education. Education inevitably means a higher standard of living; and that means a demand for the goods and services we have. No doubt, some people think of industry in terms of power and riches, and want schools so that efficient workers can be obtained for their industries. It is obvious that in China there still are people who think this way, just as there are such people in this country. But people in China are watching what is happening in this country, and may well take their cue to some extent, from what happens here. If it is found possible in this country to do away with unemployment and slums and child labor, to have efficient farming, but not at the expense of Oakies and Joads, it will strengthen those groups in China who want that kind of thing, too. If, on the other hand those people prevail who think that development can come about only by the kind of stimulus that allows cartels to run industry, manage to take control of the country, the effects will ordinarily be felt in China. There is, however, one joker in this. In China, the politicians are very realistic people; and it may be extremely difficult for foreign groups to gain complete domination of political groups in China. After what the Chinese have gone through, it seems likely that most of them will put their nationalism first, and, while they are willing to accept advice from the foreigner, they will legislate in such a way that foreign capital in China will be strictly controlled. This will apply to foreign scientists and educators, too, if it is thought that these will be manipulated for maintaining a foothold in China. Some people think that the present control of the rate of exchange of foreign funds is a clear indication of the kind of method that can be employed effectively by the Chinese. As you know, the American dollar purchases very little in China today, and each month is purchasing less.

I THINK these brief remarks will give you an outline in its simplest form of the structure of the forces at work in China.

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FUNDAMENTALS OF ELECTRICITY

Continued from page 19

motor appears everywhere that electrical energy is available for transfer into mechanical form.

A review of the principles of the electric generator should provide ready insight into the nature of A.C. and D.C. motors.

Instruction here, as in the work on generation of electrical energy, should be focused upon the fundamental principles underlying the work of motors, and upon the practical problems of operation and maintenance. The student should have abundant experience in handling motors under varying load conditions.

Illustrative Activities

1. The similarity of generators and motors may be shown graphically by using a simple generator constructed by a student in the work of the last unit and attaching the brushes to a source of about two volts of direct current. An automobile generator connected to a storage battery will run as a motor.
2. Simple experiments may be conducted to illustrate the principle and the operation of the electric motor. The St. Louis type or other simple motor may be used to great advantage.
3. The distinctions and relative advantages of a series-wound, shunt-wound, or compound-wound motor may be studied by use of the St. Louis motor or any other type in which the field and armature leads may be altered. Discussion may be centered on the use of the three types of motors. One example of the possibility of a series-wound motor being harmed when the load is relieved is the danger of keeping the foot on the starter button of an automobile after the engine is running and has therefore relieved the load on the electric motor.
4. Through diagrams and demonstration, the production of back electromotive force due to the generator action of an electrical motor may be made clear. Students should become familiar with the principle in-

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volved in the operation of starting boxes and variable resistances on motors.

XII. MUTUAL AND SELF-INDUCTION

THERE are many instances of the importance of induction coils in the mechanisms of warfare. For example, induction is employed in producing the high voltages necessary to operate X-ray equipment and the ignition systems of automotive vehicles; it is at work in the step-up and step-down transformers essential in the transmission of power over long distance.

The approach to providing a basic understanding of the topic should be made through experiences illustrating the principles and nature of transformers and induction coils. It should be focused on the actual devices used in motor vehicles, transmission lines, and telephone circuits. Self-induction, inductance, and capacitance in circuits should be seen by the student in terms of practical use. Another important device for study is the telephone. Emphasis should be placed upon the principles of construction and operation.

Illustrative Activities

1. Mutual inductance may be studied in connection with experiments in which the induced current is detected by a galvanometer reading. A bar magnet may be plunged into the center of a coil of wire, the ends of which are attached to a galvanometer. The action of the dial pointer should be noted when the magnet is in motion and when it is at rest. The bar magnet may be replaced by an electromagnet connected to two or three dry cells in series and the experiment repeated. Finally, a key may be placed in the circuit with the electromagnet. The electromagnet should be left stationary inside the secondary coil, and the key opened and closed.
2. Discussion of the foregoing experiments may be directed to a consideration of the practical uses of mutual inductance if some device is available for the making and breaking of the current. The students might construct a simple induction coil by using an electric bell or buzzer to provide the make and break device. The operation of this induction coil should be studied

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and ammeter readings of the primary current and that induced on the secondary coil should be made.

3. An automobile induction coil may be utilized, operated from dry cells in series or from a storage battery. The terminals from the secondary coil may be connected to rounded terminal points such as those found on electrostatic machines or Leyden jars, to illustrate the fat spark that it is possible to produce.
4. The value of the condenser in cutting down arcing across the contact points of the primary coil and in increasing the size of the spark across the terminals of the secondary coil may be studied by removing the condenser from an induction coil and operating coil. Condensers of various capacities may be placed in the circuit to determine the effects on arcing and on size of spark.
5. The automobile ignition system should receive careful attention in this project. The shop or vocational agriculture teacher may have diagrams and mock-ups of automobile ignition systems, and may be willing to demonstrate the nature and action of the automobile induction coil, distributor, and spark plugs.
6. Door-bell or toy transformers may be studied for construction and operation. Simple transformers may be made in which the formula for voltage and amperage output and input may be checked against the actual operation (account for loss in power due to less than 100% efficiency).
7. Discussion of transformers should be focused on the transmission of current over long distances and the greater efficiency of high voltage transmission due to lessened heat loss.
8. A rough model of a telephone transmitter may be made by crushing a carbon rod from a dry cell, placing it on a tin can lid supported on a drum and placing another tin can lid on top of the carbon particles. If the tins are connected by wires to a telephone receiver or radio

headset in series with a dry cell, sounds will be heard through the receivers when the drum is tapped. It may be possible to hear the human voice if the carbon particles are adjusted and the mouth is held close to the drum head.

9. A telephone transmitter and receiver may be dismantled and studied. They may be hooked up in a series with several dry cells to provide a simple telephone system.
10. The apparent lack of exact operation of Ohm's law in an A.C. circuit, because of self-induction, may be observed by shunting a large coil of many turns of wire around an iron core across a six-volt light bulb and connecting to a storage battery. From the demonstration and discussion, students will come to understand the effect of the back electromotive force in raising the resistance of the coil when the circuit is closed or opened.
11. Students should understand the definition of impedance in terms of the combined effects of resistance and self-induction (more properly reactance). It is important to see than Ohm's law applies to alternating as well as direct circuits if impedance is used rather than resistance.

XIII. RECTIFICATION OF CURRENT

THE VALUES and specific advantages of A.C. and D.C. currents should be thoroughly understood by the student. The type of preinduction training desirable here is that which enables him to realize the necessity of providing conversion of alternating to direct current and vice versa. The student should acquire some knowledge of the nature and operation of motor-generator converters, copper oxide rectifiers, tungar rectifiers, and vacuum tubes.

Illustrative Activities

1. A motor-generator converter may be constructed by making a mechanical connection between an alternating current motor and a direct current generator (or motor which may be used as a generator). The connection can be made through a friction

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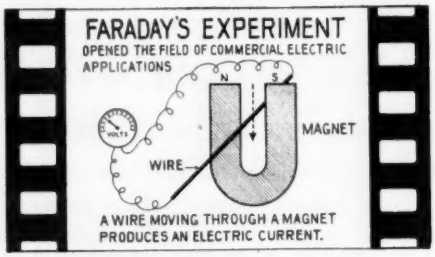

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clutch constructed of clutch facings fastened to wooden disks.

2. An electrolytic rectifier may be made by placing an aluminum electrode and a carbon or copper electrode in a bicarbonate of soda solution (about four or five teaspoonfuls to a quart of water). Connect to a bell or toy transformer. Draw off the current through terminals made by severing one of the leads to the electrolytic cell. The constant magnetic polarity of a coil connected to the terminals and tested by a compass will indicate that the current has been rectified.
3. The copper-oxide rectifier may be demonstrated. (A trickle charger obtainable from an automobile supply store, is a copper-oxide rectifier.)
4. Discuss the action of electrolytic rectifiers. The electrolytic rectifier described above works because of polarization when the aluminum electrode is positive. This prevents a flow of current until the aluminum electrode become negative. The copper-oxide rectifier operates because current will pass from the copper oxide to the copper but not from the copper to the copper oxide.
5. The rectification of current by the vacuum tube may be explained by use of diagrams.
6. The tungar rectifier should also be explained by the use of diagrams. The possibility of connecting vacuum tube and tungar rectifying tubes so as to produce full-wave rectification may be noted.

★

THE FOOD INDUSTRY

Continued from page 23

tionally superior to processed foods. By careful handling dehydrated foods may be put into the hands of the Army or the public higher in vitamins than the housewife can ordinarily obtain from fresh vegetables at the local grocer.

Temperature control, degree of vacuum, type of blanch, time of dehydration, packaging, and the use of nitrogen and CO_2 in containers are just a few of the problems that have been solved in the food laboratory.

REHYDRATION must be worked out for each vegetable because as in the case of

beets the dehydration ratio is 10-1 and the rehydration ratio is 1-7, while in the case of cabbage the hydrated product recovers 89% of the moisture it gave up during the process of dehydration. The color, the flavor, the aroma, and the texture of the dehydrated produce are all dependent upon the care that is taken in the rehydration process. In most cases the unsatisfactory experience with dehydrated vegetables have been caused by careless handling of the product in the kitchen and, in a lesser degree, to inferior dehydrated products put on the market to meet wartime needs.

The laboratory in the food industry is relatively new and is at present playing a more important role in properly feeding a nation at war. Its future knows no bounds beyond those that bound science. ★

NEW BOOKS

Basic Air Navigation. Elbert F. Blackburn, Chief Navigation Instructor, Atlantic Division, Pan American Airways System. McGraw-Hill Book Company, N. Y., 1944. 300 pp., 14x22 cm., 325 illus. $3.00.

Elementary Topography and Map Reading. Samuel L. Greitzer, Instructor in Mathematics and Navigation, High School of Science, N. Y. C. McGraw-Hill Book Company, N. Y., 1944. 157 pp., 19x22 cm.

Mathematics for Navigators. Delwyn Hyatt, Head of Dept. of Seamanship and Navigation, U. S. Merchant Marine Academy, Kings Point, N. Y.; Bennett M. Dodson, Commanding Officer, U. S. Merchant Marine Cadet Basic School, Pass Christian, Miss. McGraw-Hill Book Co., N. Y., 1944. 106 pp., 13x19.5 cm., 78 illus. $1.25.

A Guide to Naval Aviation. Lt. Wallace W. Elton, USNR, Senior Instructor; Lt. Alfred H. Driscoll, USNR; Lt. Robert N. Burchmore, USNR; Lt. Gray B. Larkum, USNR. Instructors in Naval Aviation, Naval Traiinng School, Quonset Point, R. I. McGraw-Hill Book Company, N. Y., 1944. 296 pp., 13x21 cm., 151 illus. $2.50.

Modern Physics. Charles E. Dull, Newark High School, Newark N. J. Revised edition. Henry Holt and Company, New York, 1943. 597 pp. illus.

Science Projects

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Biology Projects

(Published, October, 1942)

Included among these projects are: loss of soil elements by leaching, test tube plants and root hairs, food elements of plants, how to make a cross section of a stem, using light to make glucose and starch, when plants breathe like people, heat of respiration in plants, what causes liquids to flow in plants, identification of trees, the house fly and what he carries, controlling insect pests, digestion, checking your posture for health, charting your teeth, susceptibility to tooth decay, making media of correct pH to grow bacteria.

47 Projects, 100 pages, mimeograph $1.25

Chemistry Projects

(Revised, March, 1943)

In this group are found examination and purification of water; testing of lubricating oil, paint, baking powder, wool, silk, cotton, rayon and linen; electroplating; metal working; hydrogenation of oil; getting sugar from corn; tanning leather and fur; making bakelite, cold cream and vanishing cream, baking powder, mirrors, ink, polish, and plastic wood.

35 Projects, 125 pages, mimeograph $1.25

General Science Projects

(Published, October, 1942)

Among the projects are the following: amateur range finding, how to navigate by sun and stars, weighing without scales, making and using solutions, seven ways to start a fire, seven ways to put out a fire, chemical indicators, a rock mineral collection, a pin hole camera, printing pictures, learning to be a radio amateur, a pendulum project, testing foods at home, digesting food with saliva, canning food, how good are the arches in your feet, surveying the teeth, and clay modeling and casting.

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BOOK SHELF

THE AIRPLANE POWER PLANT. Francis Pope, Lt. Colonel, Army Air Corps; Arthur S. Otis, Pilot and Technical Member of Institute of Aeronautical Sciences. World Book Company, Yonkers-on-Hudson 5, N. Y. 188 pp., 13x20 cm., 104 illus. $1.40. Teachers Manual and Key with Tests, 38 pp. 0.28.

The Airplane Power Plant is well suited to the high school level and presents the material of this area in a simple and interesting way. Features that would be beyond their level are only mentioned briefly. The fundamental principles of science that explain the operation of the motor are not neglected and are presented in simple form that should make the work easy to master.

Adequate use is made of the overview to give the student an over-all picture of what he later studies in detail. Simplified illustrations help greatly to make the thought clear.

VITALIZED FUNDAMENTALS OF MACHINES; and VITALIZED FUNDAMENTALS OF ELECTRICITY. Both books by Robert H. Carleton, Head of Department of Science, Summit High School, Summit, N. J. College Entrance Book Company, N. Y., 1944. 186 and 184 pp. respectively, 12x19 cm., illus., paper cover. Each, 45 cents.

Each book follows the pre-induction training course in its area as outlined in the War Department manual PIT-101 which is recommended to high schools by the U. S. Office of Education.

The books are designed for those boys who will later enter the armed forces. It is intended for student use as an aid to class room study and later for use as a convenient hand book and review text.

The books are very well illustrated. The diagrams are done in two colors, red and black, in such a way as to vividly bring out the most important features and fix them in the student's mind.

SO YOU WANT TO BE A CHEMIST. Herbert Coith, Associate Chemical Director, the Proctor and Gamble Company, McGraw-Hill Book Company, N. Y., 1943. 128 pp. 12x18.5 cm.

Often young people of high school and college age want to know what the work of the chemist is like, esepcially if they are somewhat interested in that area. This book answers that question in an honest, straight forward manner that does not over sell chemistry, but does show its importance and tells what it takes to be a chemist. It may disillusion some of those romantic day dreamers from specializing in chemistry; but, on the other hand, it may encourage others in the field who have good common sense and a will to succeed.

The book should be in every high school and college library.

BELOVED SCIENTIST. David O. Woodbury, with a foreword by Owen D. Young. Whittlesey House, N. Y., 1944. 358 pp. 15x22 cm., illus. $3.50.

Beloved Scientist is interesting not only because it presents the biography of a great man, influential in the scientific world, but also because in it we follow the historical development of the electrical industry and become acquainted through quite personal glimpses with the life and work of other great men in this area, such as Edison, Westinghouse, and Steinmetz.

The life of Thompson itself is most interesting and inspiring not only because he developed as a young precocious experimenter, but also because he grew into a great inventor, a great teacher, and a great leader in scientific thinking and education.

FIGHTING FITNESS. C. Ward Crampton, M. D. Whittlesey House, N. Y., 1944. 251 pp., 13x20 cm., illus. $2.00.

Fighting Fitness is written as a guide to the individual in making himself physically fit and in the best condition to render his country the best possible service. It gives tests and training methods used in the army and navy. The book "discusses athletic sports and games, exercises, grass drills, Commando or Ranger methods, individual combat events, military swimming and obstacle races" and is aimed directly toward military objectives.

The book is well suited to use of the high school and college boy and of the instructor and coach.

MAP READING AND AVIGATION. Richard M. Field, Princeton University; and Harlan T. Stetson, Massachusetts Institute of Technology. D. Van Nostrand and Company, New York City, 1942. 129 pp. 21x28 cm. 83 illus. $2.50 list.

This book meets a demand for essential material for introductory courses in map reading and aerial navigation. Its aim is to prepare students to interpret aerophotographs for the purpose of avigation, to understand contour maps and visualize the terrain as there presented, to know the types of terrain of North America, to understand the relation of latitude and longitude to the apparent position of a celestial body at a given time, and to gain familiarity with the determination of

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College Physics-3rd Edition

By **Arthur L. Foley, Indiana University**

This is a widely adopted text for use of students in the arts and science. The material is well organized, the illustrations are interesting and the problems are practical and thought-provoking. 470 Illus. 757 Pages. $3.75 (1941)

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course and distance by the use of avigation charts and the compass. Many excellent aerial photographs are included for study. The book is well illustrated, attractive, and easy to read.

RACES OF MANKIND, Ruth Benedict, Gene Weltfish. Public Affairs Pamphlet, 32 pages, 10 cents. Quantity discount available from American Association of Scientific Workers, 18 Washington Sq., New York 11, N. Y.

A most timely booklet that should be in the hands of every high school boy and girl. Science's answers to widespread notions of racism are summarized succinctly by two renowned anthropologists of Columbia University. The presentation is non-technical and cleverly illustrated throughout. It answers the common questions concerning origins, skin color, brain size, blood types, and terms such as *Aryan* and *nationality*. This booklet is a real contribution to the war against Fascism.

ELECTRONIC PHYSICS, Hector, Lein, Scouten. Blakiston. 355 pages, $3.75.

This booklet is of interest to those seeking a different approach to electricity, magnetism and light. Electrical phenomena are studied from the electron-proton point of view. The other phenomena are shown to be various aspects of electrical principles. The book is profusely illustrated with color. J. S.

VITALIZED PHYSICS, Carleton. 384 pages, paper cover. College Entrance Book Co., New York, 1943. 50 cents.

This elementary text in general physics is brought up to date with the inclusion of references to radio and aviation. The graphic nature of its profuse illustrations is decidedly effective. The text has been edited by Michael N. Idelson, whose previous work in this feld is widely known. J. S.

WINGS FOR AMERICA. Marshall Dunn, author of "Science and Modern Progress", and Lloyd N. Morrisett, University of California. World Book Company, Yonkers-on-Hudson, New York, 1943. Price, $1.00.

Wings for America tells briefly the amazing story of American aviation—from balloons to Flying Fortresses within forty years. The book is packed with inspiration for air-minded boys and girls. It is simply written, yet comprehensive.

The book gives a broad picture of "The Business of Flying", describing how the air lines operate and the specialized training of the men who fly and maintain the planes. The chapter, "Flying for America", tells the steps by which a man becomes a pilot in the Army Air Forces and how another learns to be a crew chief in the ground crew. The science of weather is presented in relation to aviation.

Although a wealth of facts are given the presentation is elementary and well within the abilities of pupils in the upper elementary grades as well as within the high school.

GALAXIES. Harlow Shapely. $2.50 list, 229 pages, Blakiston 1943.

Those familiar with the previous issues of the Harvard Books on Astronomy will welcome this latest addition with anticipated pleasure. By the aid of modern photographic telescopes, Shapely leads his reader through space hundreds of millions of light years distant. The Clouds of Magellan is treated as the toolhouse of the astronomy of galaxies. Questions relating to the finiteness of the universe, expanding universe, amount of material in the stars and interstellar space are ably treated. The book is well illustrated. It is well made and beautifully bound, as those familiar with this series know. J. S.

INTRODUCTORY SHOPWORK. Mack M. Jones, Professor of Agricultural Engineering, University of Missouri, and Aaron Axelrod, Instructeor of Machine Shop Science, Bayonne Vocational High School, Bayonne, New Jersey. McGraw-Hill Book Company, New York, 1943. 290 pp., 15x23 cm. 364 illus. $2.00 list.

This book is a text and reference in shopwork. It is designed to supplement the work of the instructor and aid the student. It deals with tools, materials, operations, and processes rather than with projects and so can be used with any type of work. Emphasis is placed on underlying reasons for principles given.

MATHEMATICS ESSENTIAL TO ELECTRICITY AND RADIO. Nelson M. Cooke, Lieut., U. S. Navy, Radio Materiel School, Naval Research Laboratory, Washington, D. C., Joseph B. Orleans, Head of the Mathematics Department, George Washington High School, New York City. McGraw-Hill Book Company, New York, 1943. 418 pp, 15x23 cm. Illus. $2.40 list..

Mathematics Essential to Electricity and Radio is useful in high school and college as a reference book in physics and as a source book of practical problems in algebra, trigonometry, and physics. The theory of electricity and radio is given at appropriate places in the text where it best fits the mathematical principles studied, extending from simple algebra through quadratic equations, logarithims, and trigonometric functions. For those wanting a mathematical background for electricity and radio this book will be most useful.

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Catalog **No. 87602** Polaroid J-Glass Polarizing Disks, in leatherette metal case....per pair **$6.00.**

Polaroid J-Film Polarizing Disks, rimmed, are similar to Polarizing Disks but with lower transmission properties, and constructed of less expensive and unbreakable materials. Packed in cardboard box with an instruction manual.

Catalog **No. 87615** Polaroid J-Film Polarizing Disks.....per pair **$2.50.**

Polaroid Experimental Kit, Hand Type, is excellent for performing many experiments and demonstrations with polarized light. It is furnished with a pair of No. 87615 Polaroid Disks and a hand polarscope fixture. Provided with the following specimens small calcite crystal; a photoelectric U; a black mirror; a disk of biaxial mica for interference; a disk with a stepped retardation series; a disk with retardation wedge to show progression of interference colors; and an instruction book.

No. 87616

Polaroid Experimental Kit, furnished in an attractive velvet-lined pocket case. Catalog **No. 87616** .....**$7.50.**

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